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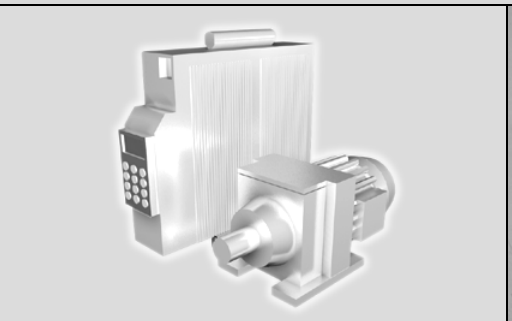
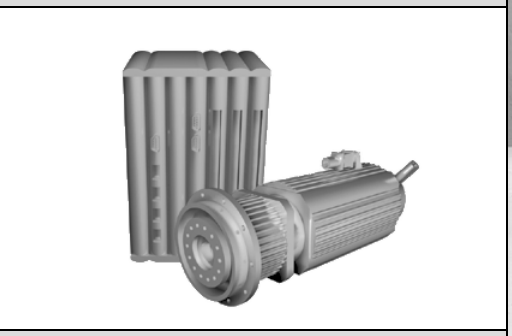
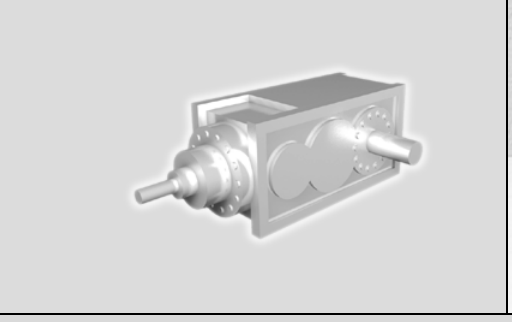




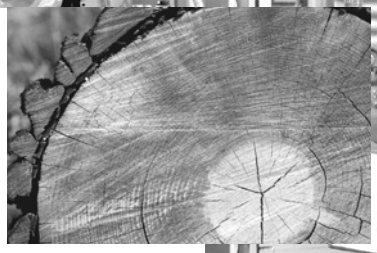


MOVIAXIS® MX Multi-Axis Servo Inverter XFE24A EtherCAT Fieldbus Interface

Edition 08/2007

11550619 / EN

Manual



SEW EURODRIVE

Contents

1 General Information

1.1 Structure of the safety notes

The safety notes in these operating instructions are structured as follows:

Symbol	SIGNAL WORD
	Nature and source of hazard. Possible consequence(s) if disregarded. • Measure(s) to avoid the hazard.

Symbol	Signal Word	Meaning	Consequences if disregarded
Example:  General hazard  Specific hazard, e.g. electric shock	**HAZARD**	Imminent hazard	Severe or fatal injuries
	WARNING	Possible hazardous situation	Severe or fatal injuries
	CAUTION	Possible hazardous situation	Minor injuries
	**STOP**	Possible damage to property	Damage to the drive system or its environment
	**NOTE**	Useful information or tip. Simplifies drive system handling	

1.2 Right to claim under warranty

A **requirement of fault-free operation** and fulfillment of any rights to claim under limited warranty is that you adhere to the information in **this manual** and the **"MOVIAXIS® Multi-Axis Servo Inverter" operating instructions**. Therefore, **read the operating instructions** before you start operating the unit!

Make sure that the operating instructions are available to persons responsible for the system and its operation as well as to persons who work independently on the unit. You must also ensure that the documentation is legible.

1.3 Exclusion of liability

You must comply with the information contained in this manual and the "MOVIAXIS® Multi-Axis Servo Inverter" operating instructions to ensure safe operation of the MOVIAXIS® multi-axis servo inverter and to achieve the specified product characteristics and performance requirements. SEW-EURODRIVE assumes no liability for injury to persons or damage to equipment or property resulting from non-observance of the operating instructions. In such cases, any liability for defects is excluded.

1.4 Integral part of the product

This manual is an integral part of the EtherCAT XFE24A fieldbus interface and contains important notes on operation and service.

1.5 Documentation note

- You must adhere to the information in the documentation to ensure:
  - Fault-free operation
  - Fulfillment of any rights to claim under limited warranty
- Consequently, read through this manual carefully before you start installation and startup of the frequency inverters with the EtherCAT XFE24A option card.
- This manual assumes that the user has access to and is familiar with the "MOVIAXIS® Multi-Axis Servo Inverter" operating instructions and the "MOVIAXIS® Multi-Axis Servo Inverter" project planning manual.

1.6 Product names and trademarks

The brands and product names in this manual are trademarks or registered trademarks of the titleholders.

1.7 Waste disposal

Please follow the current national regulations.

Dispose of the following materials separately in accordance with the country-specific regulations in force, as:

- Electronics scrap
- Plastics
- Sheet metal
- Copper, etc.

2 Safety Notes

The following basic safety notes are intended to prevent injury to persons and damage to property. The operator must make sure that the basic safety notes are read and observed. Make sure that persons responsible for the plant and its operation, as well as persons who work independently on the unit, have read through this manual and the "MOVIAXIS® Multi-Axis Servo Inverter" operating instructions carefully and understood them." If you are unclear about any of the information in this documentation, or if you require further information, please contact SEW-EURODRIVE.

	**NOTE**
	This communication system allows you to adjust the MOVIAXIS® multi-axis servo inverter to a variety of different applications. **As with all bus systems, there is a danger of invisible, external (as far as the servo drive is concerned) modifications to the parameters which give rise to changes in the unit behavior. This may result in unexpected (not uncontrolled) system behavior.**

2.1 General information

Never install damaged products or take them into operation. Submit a complaint to the shipping company immediately in the event of damage.

During operation, multi-axis servo inverters can have live, bare and movable or rotating parts as well as hot surfaces, depending on their enclosure.

Removing covers without authorization, improper use as well as incorrect installation or operation may result in severe injuries to persons or damage to property.

Refer to the documentation for more information.

2.2 Target group

Only qualified personnel are authorized to install, startup or service the units or correct unit faults (observing IEC 60364 or CENELEC HD 384 or DIN VDE 0100 and IEC 60664 or DIN VDE 0110 as well as national accident prevention guidelines).

Qualified personnel in the context of these basic safety notes are persons familiar with installation, assembly, startup and operation of the product who possess the necessary qualifications.

All activity in the other areas of transportation, storage, operation, and disposal must be carried out by persons who are appropriately trained.

2.3 Transport / putting into storage

You must observe the notes in the manual on transportation, storage and proper handling.

2.4 Installation / assembly

Adhere to the instructions in section 4, "Mechanical Installation"

2.5 Electrical Connection

Observe the applicable national accident prevention guidelines when working on live multi-axis servo inverters (for example, BGV A3).

Perform electrical installation according to the pertinent regulations (e.g. cable cross sections, fusing, protective conductor connection). Additional information is contained in the documentation.

You will find notes on EMC-compliant installation, such as shielding, grounding, arrangement of filters and routing of lines, in the documentation of the multi-axis servo inverters. Always observe these notes even with multi-axis servo inverters bearing the CE marking. The manufacturer of the system or machine is responsible for maintaining the limits established by EMC legislation.

Preventive measures and protection devices must correspond to the regulations in force (e.g. EN 60204 or EN 61800-5-1).

Required preventive measures: The unit must be grounded.

All electrical connection cables may only be plugged or unplugged in a de-energized state.

2.6 Startup / operation

You are allowed to perform installation and startup of the EtherCAT XFE24A fieldbus interface only when observing applicable accident prevention regulations and the "MOVIAXIS® Multi-Axis Servo Inverter" operating instructions!

Adhere to the instructions in section 5, "EtherCAT Configuration and Startup".

3 Introduction

3.1 Content of the manual

This user manual describes

- MOVIAXIS® startup on the EtherCAT fieldbus system.
- The configuration of the EtherCAT master using XML files.
- Operating MOVITOOLS® MotionStudio via EtherCAT.

3.2 Additional documentation

For information on how to connect MOVIAXIS® straightforwardly and effectively to the EtherCAT fieldbus system, in addition to this user manual on the EtherCAT option, you should request the following publication:

- "MOVIAXIS® Multi-Axis Servo Inverter" operating instructions
- "MOVIAXIS® Multi-Axis Servo Inverter" project planning manual

The "MOVIAXIS® Multi-Axis Servo Inverter" project planning manual contains a list of all parameters of the servo inverter that can be read or written via the various communication interfaces, such as system bus and also via the fieldbus interface.

3.3 Features

The MOVIAXIS® multi-axis servo inverter enables you to use the XFE24A option to connect to higher-level automation systems via EtherCAT thanks to its powerful, universal fieldbus interface.

3.3.1 MOVIAXIS® and EtherCAT

The unit behavior of the servo inverter which forms the basis of EtherCAT operation is referred to as the unit profile. It is independent of any particular fieldbus and is therefore a uniform feature. This feature allows the user to develop fieldbus-independent drive applications. This makes it much easier to change to other bus systems, such as Profibus (option XFP11A).

3.3.2 Access to all information

MOVIAXIS® offers digital access to all drive parameters and functions via the EtherCAT interface. The servo drive is controlled via fast, cyclic process data. Via this process data channel, you can enter setpoints such as the setpoint speed, ramp generator time for acceleration / deceleration, etc. as well as trigger various drive functions such as enable, control inhibit, normal stop, rapid stop, etc. At the same time you can also use this channel to read back actual values from the servo inverter, such as actual speed, current, unit status, error number or reference signals.

3.3.3 Cyclical data exchange via EtherCAT

Process data is usually exchanged cyclically between EtherCAT master and the MOVIAXIS® multi-axis servo inverter. The cycle time is determined when configuring the EtherCAT master.

3.3.4 Acyclical data exchange via EtherCAT

Acyclical READ- / WRITE services are introduced in line with the EtherCAT specification. They are transmitted during normal cyclical operation along with the messages without affecting the performance of the process data communication via EtherCAT.

READ / WRITE access to the drive parameters is enabled using SDO services (Service Data Objects), which are implemented via CoE (CANopen over EtherCAT) or VoE services (Vendor-specific over EtherCAT).

This parameter data exchange enables you to implement applications in which all the important drive parameters are stored in the master programmable controller, so that there is no need to make parameter settings manually on the servo drive itself.

3.3.5 Configuration of the EtherCAT option card

The EtherCAT option card is designed so that all specific fieldbus settings are made when the EtherCAT system starts up. This means the servo inverter can be integrated into the EtherCAT environment and switched on within a very short period of time.

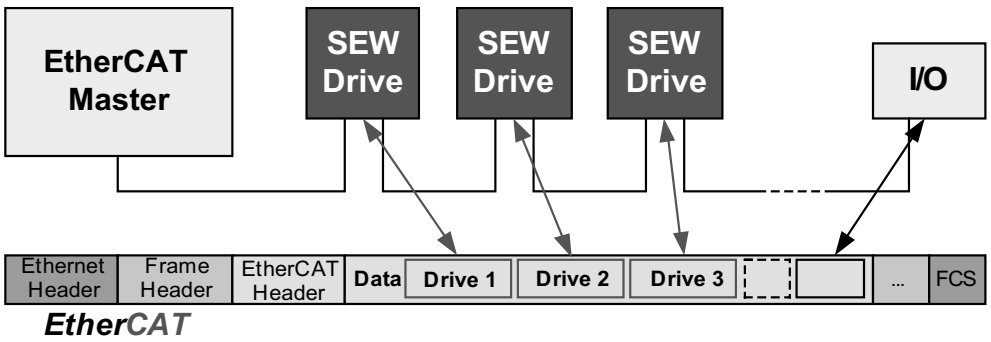


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Figure 1: EtherCAT with MOVIAXIS®

3.3.6 Monitoring functions

Using a fieldbus system requires additional monitoring functions for the drive technology, for example, time monitoring of the fieldbus (fieldbus timeout) or rapid stop concepts. You can, for example, adapt the monitoring functions of MOVIAXIS® specifically to your application. You can determine, for instance, which of the servo inverter's fault responses should be triggered in the event of a bus error. It is a good idea to use a rapid stop function for many applications. However you can also freeze the last setpoints so that the drive continues to operate with the most recently valid setpoints (for example, conveyor belt). As the range of functions for the control terminals is also guaranteed in fieldbus mode, you can continue to implement rapid stop concepts using the terminals of the servo drive, irrespective of the fieldbus used.

3.3.7 Diagnostics

The MOVIAXIS® multi-axis servo inverter offers numerous diagnostic options for startup and service. For example, you can use the integrated fieldbus monitor to control setpoint values sent from the higher-level controller as well as the actual values.

3.3.8 PDO Editor

Furthermore, you are supplied with a variety of additional information about the status of entire process data flow. The PDO Editor in conjunction with the MOVITOOLS® MotionStudio PC software offers you an easy-to-use diagnostic tool for setting all drive parameters (including the fieldbus parameters) and for displaying the fieldbus and unit status information in detail.

4 Assembly and Installation

4.1 Prerequisites

For operation on EtherCAT bus systems, only MOVIAXIS® units that fulfill the following criteria may be used:

- The designation "XFE24A" is on the nameplate,
- The component XFE24A has already been installed at the factory. For information on the option card slots, refer to the "MOVIAXIS® Multi-Axis Servo Inverter" operating instructions.

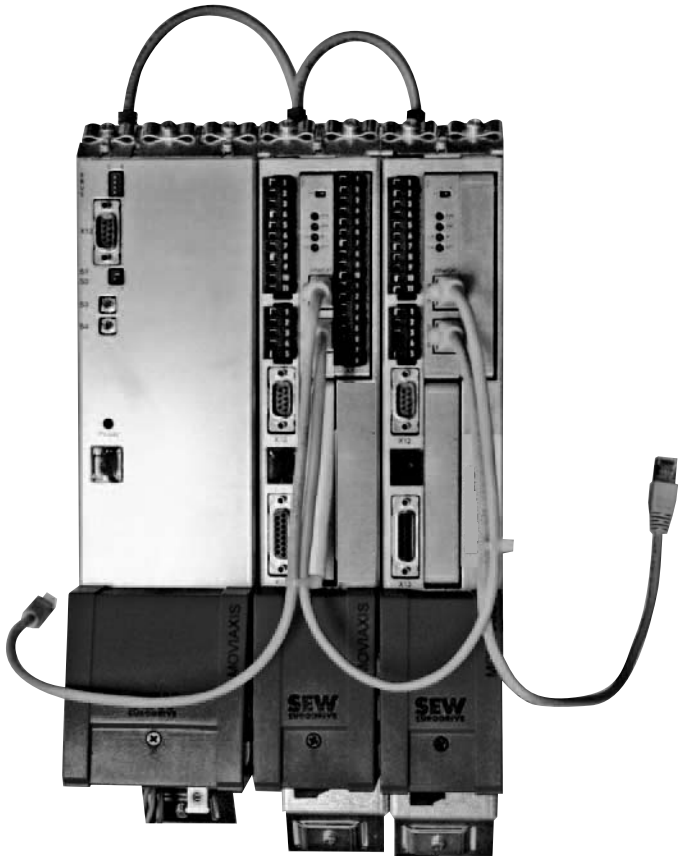

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Figure 2: MOVIAXIS® axis system with XFE24A fieldbus card

	NOTE
	For the installation of the EtherCAT bus, you can use commercially available cables that are intended for EtherCAT bus systems. The EtherCAT cables are not included in the scope of delivery of SEW-EURODRIVE.

4.2 Pin assignment

Use prefabricated, shielded RJ45 plug connectors compliant with IEC 11801, edition 2.0, category 5.

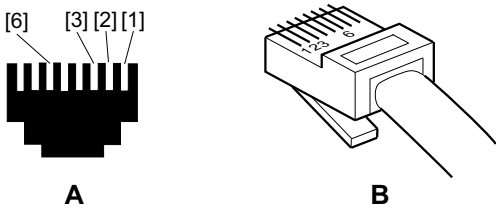


Figure 3: Pin assignment of an RJ45 plug connector

A = Front view

B = View from back

[1] Pin 1 TX+ Transmit Plus

[2] Pin 2 TX– Transmit Minus

[3] Pin 3 RX+ Receive Plus

[6] Pin 6 RX– Receive Minus

XFE24A - EtherCAT connection

The XFE24A option is equipped with a linear bus structure with two RJ45 connectors. The EtherCAT master is connected (via EtherCAT slaves, if necessary) with a shielded twisted pair cable to X30IN (RJ45). Other EtherCAT units are then connected vie X31OUT (RJ45).

According to IEC 802.3, the maximum cable length for 100 MBaud Ethernet is 100 m (100BaseT), e.g. between 2 XFE24A interfaces.

4.3 Routing and shielding the bus cable

Only use shielded cables and connection elements that also meet the requirements of category 5, class 2 according to IEC11801, edition 2.0.

Correct shielding of the bus cable attenuates electrical interference that may occur in industrial environments. The following measures ensure the best possible shielding:

- Manually tighten the mounting screws on the connectors, modules, and equipotential bonding conductors.
- Use only connectors with a metal housing or a metallized housing.
- Connect the shielding in the connector over a wide surface area.
- Apply the shielding of the bus cables on both ends.
- Route signal and bus cables in separate cable ducts. Do not route them parallel to power cables (motor leads).
- Use metallic, grounded cable racks in industrial environments.
- Route the signal cable and the corresponding equipotential bonding, if necessary, close to each other using the shortest possible route.
- Avoid using plug connectors to extend bus cables.
- Route the bus cables closely along existing grounding surfaces.

In case of fluctuations in the ground potential, a compensating current may flow via the bilaterally connected shield that is also connected to the protective earth (PE). Make sure you supply adequate equipotential bonding according in accordance with relevant VDE regulations in such a case.

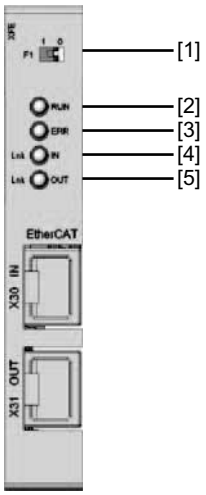
4.4 Bus termination

A bus terminator (e.g. using bus terminating resistors) is not necessary. If no follow-up unit is connected to an EtherCAT unit, this is automatically detected.

4.5 Setting the station address

The address of EtherCAT units from SEW-EURODRIVE cannot be set at the unit. These units are recognized via their position in the bus structure and are then assigned an address by the EtherCAT master. This can be displayed in MOVITOOLS® MotionStudio or via Index 8454.0.

4.6 Operating displays and settings



[1] Switch F1
- Switch position 0: Delivery condition
- Switch position 1: Reserved for added functions

[2] LED RUN; color: Green / orange

[3] LED ERR; color: Red

[4] LED link IN; color: Green

[5] LED link OUT; color: Green

Switch F1 must be set to position 0.

RUN LED green / orange

The LED **RUN** (green / orange) indicates the status of the XFE24A option.

Status	State	Description
Off	INIT	The XFE24A option is in the INIT state.
Flashing green	PRE-OPERATIONAL	The XFE24A option is in the PRE-OPERATIONAL state.
Flashing once (green)	SAFE-OPERATIONAL	The XFE24A option is in the SAFE-OPERATIONAL state.
Green	OPERATIONAL	The XFE24A option is in the OPERATIONAL state.
Flickering green	INITIALISATION or BOOTSTRAP	• The XFE24 option is starting up and has not yet reached the INIT state. • The XFE24A option is in the BOOTSTRAP state. The firmware is being downloaded.
Flashing orange	NOT CONNECTED	The XFE24A option was not yet addressed by an EtherCAT master after switching it on.

ERR LED red

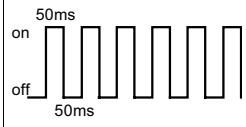
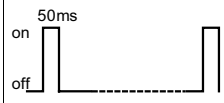
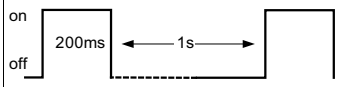
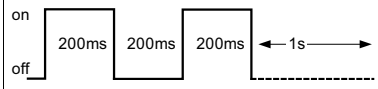
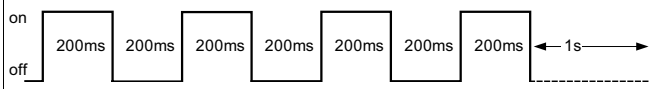
The LED **ERR** (red) indicates an EtherCAT error.

Status	Error	Description
Off	No error	The EtherCAT communication of the XFE24A option is in operating state.
Flickering	Boot error	A boot error was detected. The INIT state was reached, but the "Change" parameter in the AL status register is set to "0x01:change/error".
Flashing	Invalid configuration	General configuration error.
Flashing once	Unprompted state change	The slave application has changed the EtherCAT state by itself. The "Change" parameter in the AL state register is set to "0x01:change/error".
Flashing twice	Timeout of the application watchdog	A watchdog timeout has occurred in the application.
Flashing three times	Reserved	-
Flashing four times	Reserved	-
On	PDI watchdog timeout	A PDI watchdog timeout occurred.

LED link IN LED link OUT

Each EtherCAT connection for incoming EtherCAT cables (X30) and outgoing EtherCAT cables (X31) has a "Link/Activity" LED. The LED shows whether the EtherCAT link to the previous unit (X30) or the next unit (X31) in line exists / is active.

Definition of display statuses

Display	Definition	Timeline
On	The display is on permanently.	
Off	The display is off permanently.	
Flickering	The display switches between on and off in common mode with a frequency of 10 Hz.	 58094AXX
Flickering once	The display flickers once very shortly, followed by an off phase.	 58095AXX
Flashing	The display switches between on and off in common mode with a frequency of 2.5 Hz (200 ms switched on, 200 ms switched off).	 58096AXX
Flashing once	The display flashes once shortly (200 ms), followed by a longer off phase (1,000 ms).	 58097AXX
Flashing twice	The display flashes twice in quick succession, followed by an off phase.	 58100AXX
Flashing three times	The display flashes three times in quick succession, followed by an off phase.	 58101AXX
Flashing four times	The display flashes four times in quick succession, followed by an off phase.	 58102AXX

5 EtherCAT Configuration and Startup

This section provides you with information on configuration of the EtherCAT master and startup of the servo inverter for fieldbus operation.

The current version of the XML file for the XFE24A option card is available on the SEW homepage (http://www.sew-eurodrive.de) under the heading "Software".

5.1 Validity of the XML files for XFE24A

The XML file is necessary for using XFE24A as a fieldbus option in MOVIAXIS®.

Entries in the XML file must not be changed or expanded. SEW assumes no liability for servo inverter malfunctions caused by a modified XML file!

5.2 Configuring the EtherCAT master for MOVIAXIS® using the XML file

5.2.1 XML file for operation with MOVIAXIS®

An XML file (SEW_XFE24A.XML) is provided for configuring the EtherCAT master . This file must be copied into a special folder of your project planning software.

Refer to the manuals for the appropriate project planning software for details on the procedure.

The XML files standardized by the EtherCAT Technology Group (ETG) can be read by all EtherCAT masters.

5.2.2 Configuration procedure

Proceed as follows for configuring MOVIAXIS® with EtherCAT fieldbus interface:

1. Install (copy) the XML file according to the requirements of your project planning software. Once the file has been installed correctly, the unit appears next to the slave stations (under SEW-EURODRIVE → Drives) with the designation *MOVIAXIS+XFE24A*.
2. Use the menu item [Insert] to add the unit to the EtherCAT structure. The address is assigned automatically. For easier identification, you can give a name to the unit.
3. Select the process data configuration required for your application (see section "PDO configuration for operation in the MOVIAXIS®").
4. Link the I/O or periphery data with the input and output data of the application program.

After configuration, you can start the EtherCAT communication. The RUN and ERR LEDs indicate the communication status of the XFE24A option (see section 4.6 "Operating displays and settings" and section 9 "Error Diagnostics").

5.2.3 PDO configuration for operation in the MOVIAXIS®

In the CoE (CANopen over EtherCAT) version, EtherCAT uses the process data objects (PDO) defined in the CANopen standard for cyclical communication between master and slave. In line with CANopen, a difference is made between Rx (receive) and Tx (transmit) process data objects.

Rx process data objects

Rx process data objects (Rx-PDO) are received by the EtherCAT slave. They transfer process output data (control values, setpoints, digital output signals) from the EtherCAT master to the EtherCAT slave.

Tx process data objects

Tx process data objects (Tx-PDO) are sent back to the EtherCAT master by the EtherCAT slave. They transfer process input data (actual values, statuses, digital input information, etc.).

For communication with MOVIAXIS® via XFE24A, there is a PDO type available for cyclical process input and output data.

- *OutputData1* (Standard 16 PO)

  Static PDO with 16 cyclical process output data words which are permanently linked with the standard process data of the MOVIAXIS® (→ "MOVIAXIS® Multi-Axis Servo Inverter" project planning manual).

- *InputData1* (Standard 16 PI)

  Static PDO with 16 cyclical process input data words which are permanently linked with the standard process data of the MOVIAXIS® (→ "MOVIAXIS® Multi-Axis Servo Inverter" project planning manual).

List of possible process data objects (PDO) for XFE24A MOVIAXIS®

Index	Size	Name	Mapping	Sync Manager	Sync Unit
1600hex (5632dez)	32 Byte	OutputData1 (Standard 16 PO)	Fixed content	2	0
1A00hex (5632dez)	32 Byte	InputData1 (Standard 16 PI)	Fixed content	3	0

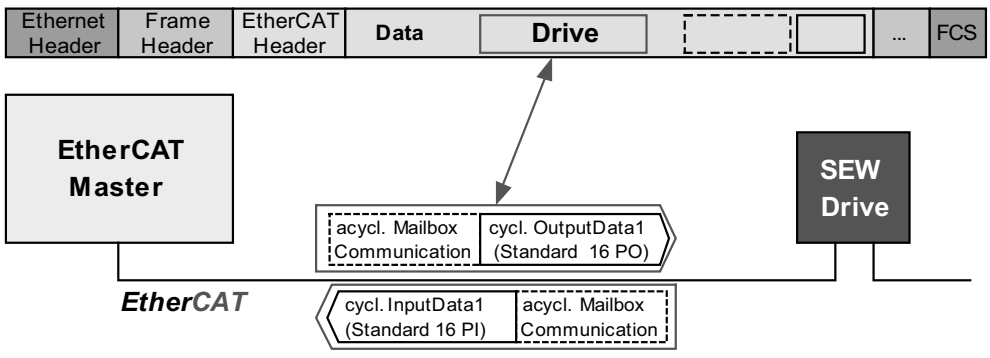


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Figure 4: Using process data objects OutputData1 and InputData1

Static PDO for 16 cyclical process data words

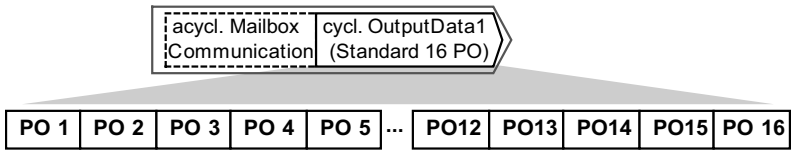

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Figure 5: Assignment of standard process output data for OutputData1

The process output data transferred with *OutputData1* are permanently assigned according to the following table. The process output data PO1 ... PO16 can be linked to different process data (control words, setpoints) via the PDO Editor in the MOVIAXIS® multi-axis servo inverter (→ "MOVIAXIS® Multi-Axis Servo Inverter" project planning manual).

Assignment of the permanently configured process output data for PDO OutputData1

Index.Subindex	Offset in the PDO	Name	Data type	Size in bytes
3DB8.0hex (15800.0dez)	0.0	PO1	UINT	2
3DB9.0hex (15801.0dez)	2.0	PO2	UINT	
3DBA.0hex (15802.0dez)	4.0	PO3	UINT	
3DBB.0hex (15803.0dez)	6.0	PO4	UINT	
3DBC.0hex (15804.0dez)	8.0	PO5	UINT	
3DBD.0hex (15805.0dez)	10.0	PO6	UINT	
3DBE.0hex (15806.0dez)	12.0	PO7	UINT	
3DBF.0hex (15807.0dez)	14.0	PO8	UINT	
3DC0.0hex (15808.0dez)	16.0	PO9	UINT	
3DC1.0hex (15809.0dez)	18.0	PO10	UINT	
3DC2.0hex (15810.0dez)	20.0	PO11	UINT	
3DC3.0hex (15811.0dez)	22.0	PO12	UINT	
3DC4.0hex (15812.0dez)	24.0	PO13	UINT	
3DC5.0hex (15813.0dez)	26.0	PO14	UINT	
3DC6.0hex (15814.0dez)	28.0	PO15	UINT	
3DC7.0hex (15815.0dez)	30.0	PO16	UINT	

Assignment of the permanently configured process input data for PDO InputData1

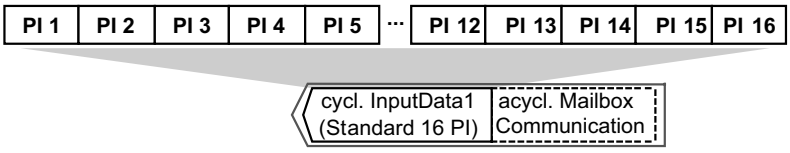

Figure 6: Assignment of standard process input data for PDO InputData1

The process input data transferred with *InputData1* are permanently assigned according to the following table. Process input data PI1 ... PI16 can be linked to different process data (status words, actual values) via the PDO Editor in the MOVIAXIS® multi-axis servo inverter (→ "MOVIAXIS® Multi-Axis Servo Inverter" project planning manual).

Index.Subindex	Offset in the PDO	Name	Data type	Size in bytes
3E1C.0hex (15900.0dez)	0.0	PI1	UINT	2
3E1D.0hex (15901.0dez)	2.0	PI2	UINT	
3E1E.0hex (15902.0dez)	4.0	PI3	UINT	
3E1F.0hex (15903.0dez)	6.0	PI4	UINT	
3E20.0hex (15904.0dez)	8.0	PI5	UINT	
3E21.0hex (15905.0dez)	10.0	PI6	UINT	
3E22.0hex (15906.0dez)	12.0	PI7	UINT	
3E23.0hex (15907.0dez)	14.0	PI8	UINT	
3E24.0hex (15908.0dez)	16.0	PI9	UINT	
3E25.0hex (15909.0dez)	18.0	PI10	UINT	
3E26.0hex (15910.0dez)	20.0	PI11	UINT	
3E27.0hex (15911.0dez)	22.0	PI12	UINT	
3E28.0hex (15912.0dez)	24.0	PI13	UINT	
3E29.0hex (15913.0dez)	26.0	PI14	UINT	
3E2A.0hex (15914.0dez)	28.0	PI15	UINT	
3E2B.0hex (15915.0dez)	30.0	PI16	UINT	

5.3 Settings on the MOVIAXIS® servo inverter using the example of single-axis positioning

Settings with software assistant

For simple fieldbus operation, the following preparations and settings are required.

- First, perform motor startup. The motor startup procedure is described in detail in the "MOVIAXIS® Multi-Axis Servo Inverter" operating instructions.
- All communication parameter and the PDO configuration are set using the "Single-Axis Positioning Technology Editor" (single-axis positioning), see "Single-Axis Positioning Technology Editor" manual.

  For positioning operation via the process data interface, we recommend using the graphical software assistant " Single-Axis Positioning" for setting all necessary parameters and configuring the process data, see "Single-Axis Positioning Technology Editor" manual.

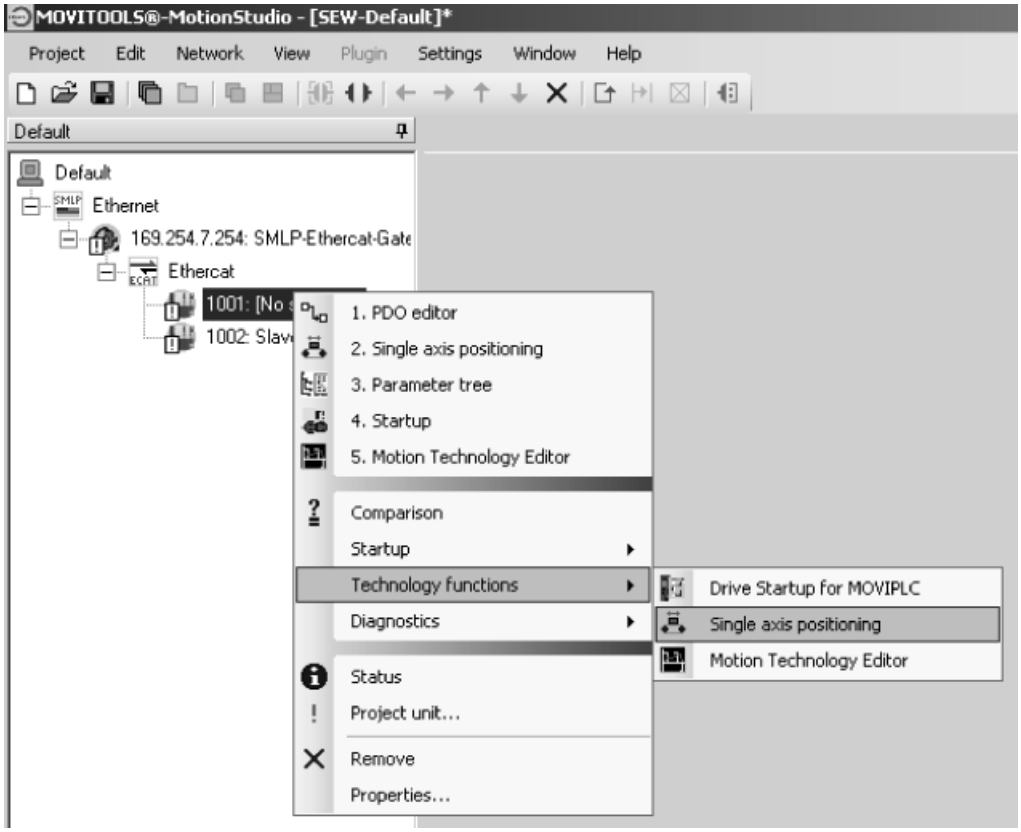

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Figure 7: Starting the Single-Axis Positioning Technology Editor

Manual settings

Manual setting of the communication and PDO configurations:

- Start the PDO Editor.

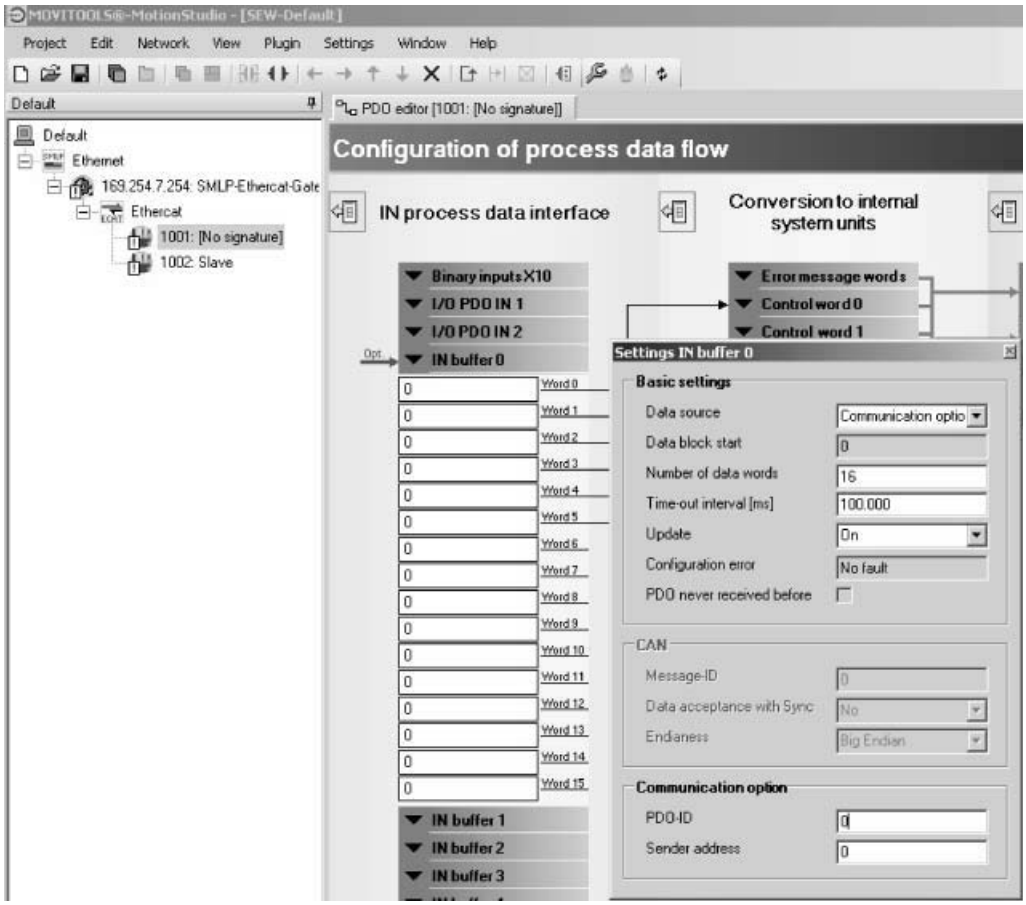

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Figure 8: Manual settings

- For operation with an EtherCAT bus system, a free "IN buffer" (e.g. IN buffer 0) must be configured:
  - Number of data words: **16** for firmware status 21

    1 ... 16 for firmware status 22 and higher

  EtherCAT with MOVIAXIS® always transfers 16 data words.

  "Number of data words" determines how many data words are used of the 16 that are transferred.

  - Time-out interval

  Here, you can set the monitoring time for the "IN buffer". If the process data communication exceeds the set time, error message 67 "Error PDO timeout" is issued.

  Setting range 0 ... 100....100000 ms (0 ms corresponds to deactivated, standard is 100 ms).

  - Update: **On**

  Updating the process data.

For safety reasons, you must also enable the MOVIAXIS® servo inverter at the terminals for control via the EtherCAT bus system. To do so, connect input DI00 (Function „Output stage enable) to DC +24 V.

The procedure for complete startup of the MOVIAXIS® servo inverter with EtherCAT link is described in the "MOVIAXIS®Multi-Axis Servo Inverter" operating instructions.

6 Operating Behavior on EtherCAT

This section describes the basic behavior of the servo inverter on the EtherCAT system when controlled via permanently configured PDOs for fieldbus communication.

6.1 Control of the MOVIAXIS® multi-axis servo inverter

The MOVIAXIS® multi-axis servo drive is controlled via the permanently configured PDOs, which are up to 16 I/O words in length. When using an EtherCAT master, the process data words are directly mapped in the process image and can so be addressed directly by the control program.

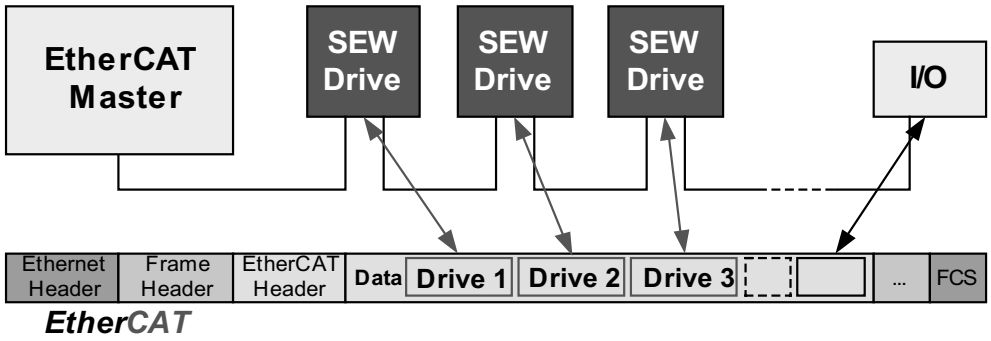

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Figure 9: EtherCAT with SEW drives

For more information about controlling via the process data channel, in particular regarding the configuration of the control and status words, refer to the "MOVIAXIS® Multi-Axis Servo Inverter" project planning manual.

For proper operation of synchronized applications, timing requirements must be met by the master depending on the synchronization mechanism.

- **Synchronization via Distributed Clock (DC):**

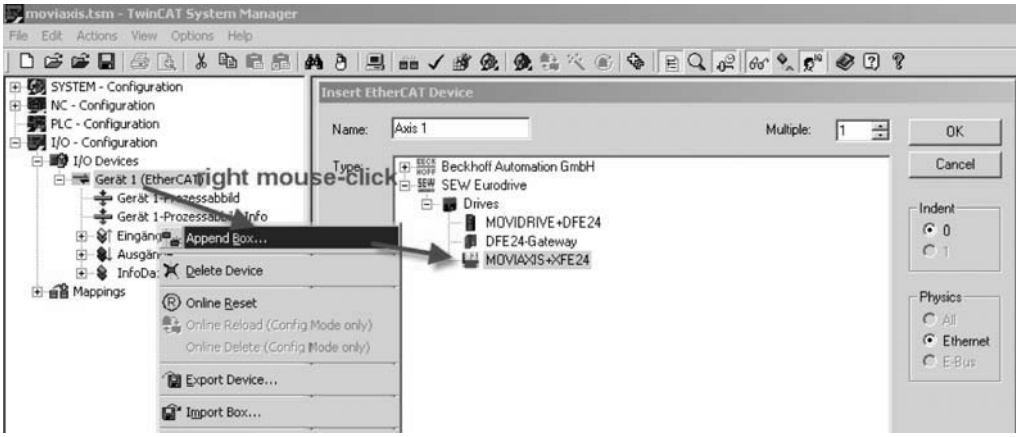
  The process data telegram must arrive shortly before the DC. Beckhoff recommends a maximum time of 10 % (in relation to the DC cycle) before the DC.

- **Synchronization via synchronized process data:**

  The MOVIAXIS® servo system can handle a maximum jitter of the EtherCAT process data telegram (setpoints of the master, etc.) of ± 40 µs. If this jitter limit is exceeded, a synchronous processing is no longer guaranteed. Please check the synchronization quality of your EtherCAT master if problems occur.

6.1.1 Control example in TwinCAT with MOVIAXIS®

Once the file *SEW_XFE24A.xml* has been copied to the TwinCAT subdirectory "\IO\EtherCAT" , you can add MOVIAXIS® to the EtherCAT structure in the "offline mode" via "Append box" (→ following figure).



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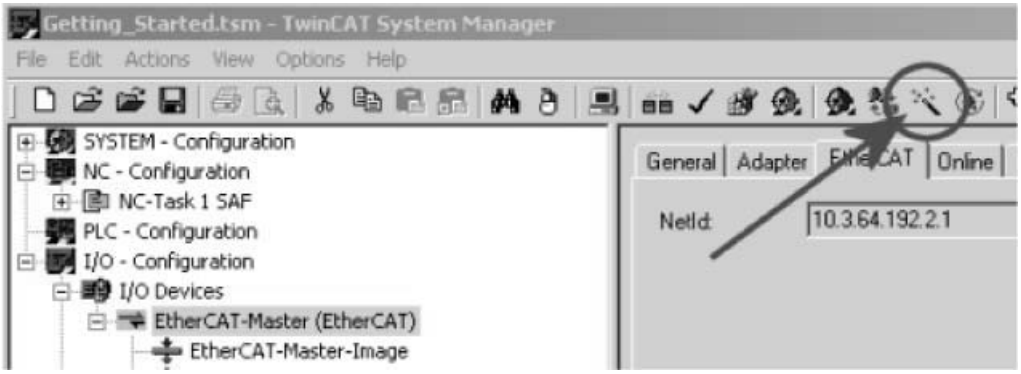
In "online mode" (i.e. connected to the EtherCAT line), you can use the Symbol "Search for units" symbol to search for MOVIAXIS® units connected to the EtherCAT line (→ following figure).



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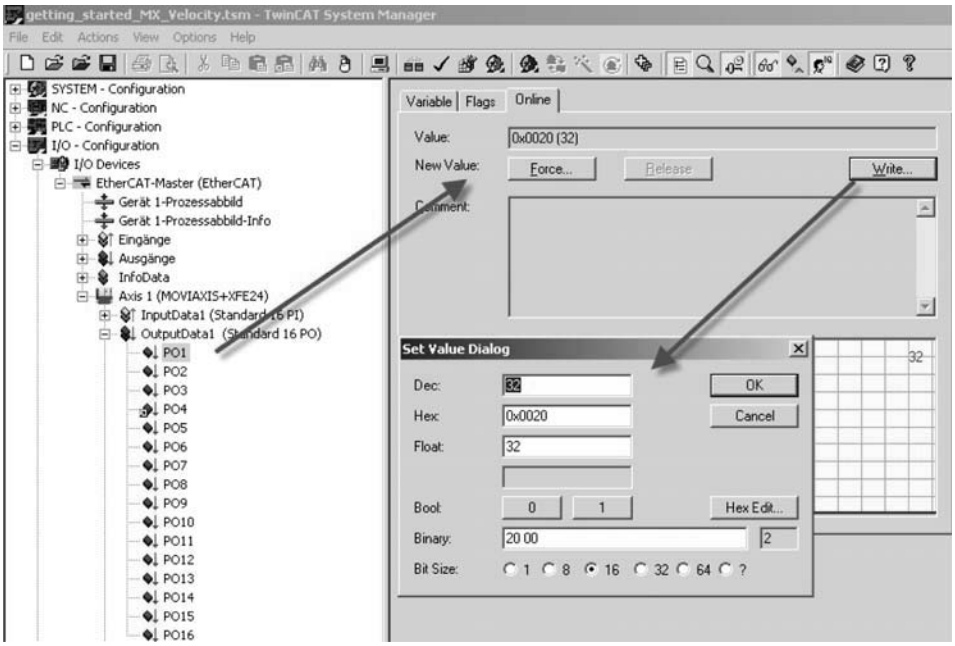
For simple fieldbus functionality, it is not necessary to create NC axes for each found unit.

Now, you can link up to 16 process data words to the PLC program or write data into them for manual testing as shown in the following figure.



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First, mark the process output data PO1. In the following window, select the "Online" tab page. Click the "Write" button. The "Set Value Dialog" window opens. Enter your data in the field "Dec" or "Hex". Handle all other process output data in the same way.

6.1.2 EtherCAT timeout monitoring (MOVIAXIS®)

Use the parameter "Communication\Basic settings\Communication option" to set the monitoring time for the EtherCAT option card XFE24A. If this monitoring time is exceeded during the process data configuration, an error message is issued, see Error response, sec. 6.1.3.

Parameter setting timeout: 0 ... 100 ... 650,000 ms.

Up to firmware status 21.5, the setting 1,000 is recommended.

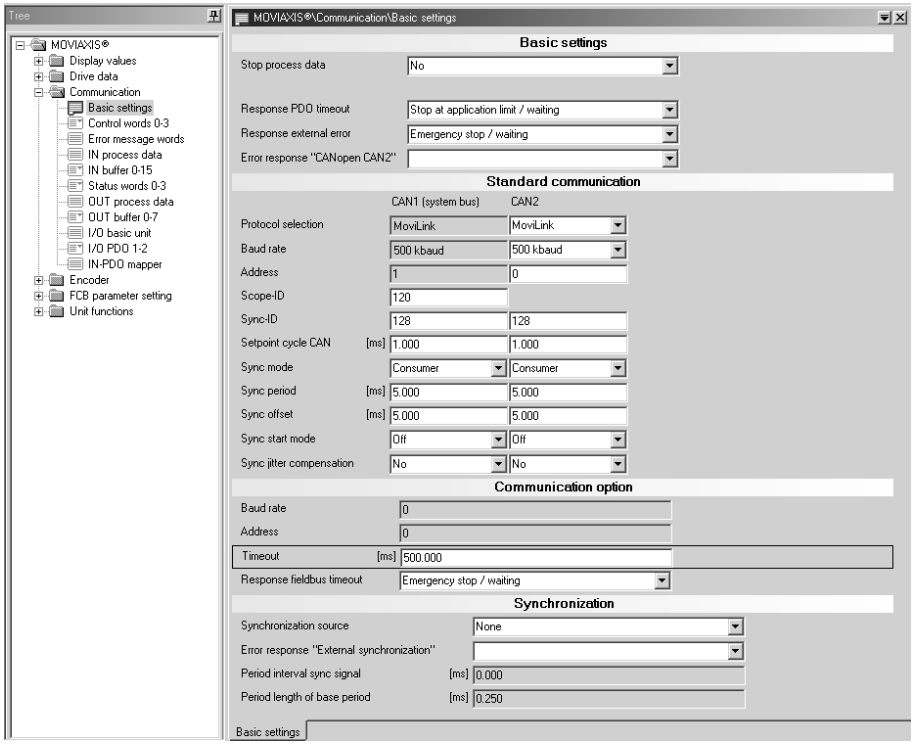

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Figure 10: Timeout communication option

6.1.3 Response fieldbus timeout

The "Fieldbus Timeout" response is used to configure the error response, which is triggered by the "fieldbus timeout monitoring". The parameters set her should match the configuration of the master system.

The standard setting of the "Fieldbus Timeout" response is: **Emergency stop / waiting**.

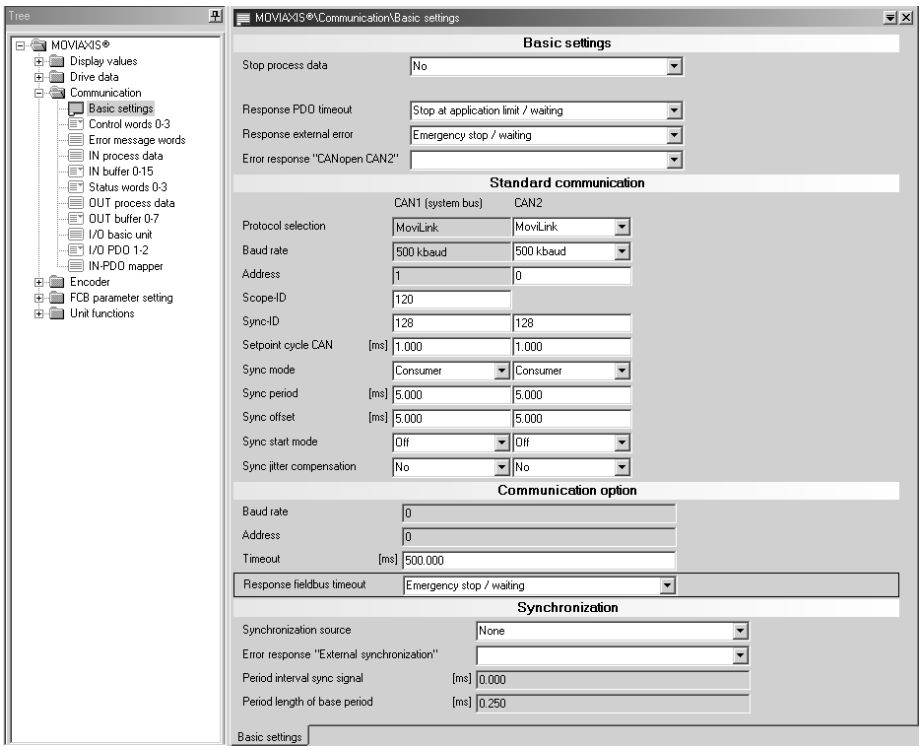

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Figure 11: Response fieldbus timeout

Value range:

- 0 = No response
- 1 = Display only
- 2 = Output stage inhibit / locked
- 3 = Stop at emergency stop limit / locked
- 5 = Output stage inhibit / waiting
- 6 = Stop at emergency stop limit / waiting
- 8 = Stop at application limit/ waiting
- 9 = Stop at application limit/ locked
- 10 = Stop at system limit / waiting
- 11 = Stop at system limit / locked

The fieldbus timeout response sets the error response for the case that the IN buffer does not receive an expected process data. The process data was already received and is then absent before the error message comes up. After a reset, the axis is in C3 status and "waits for process data" (no error but a status).

6.2 Parameter setting via EtherCAT

The SDO services READ and WRITE, which are common in CoE (CANopen over EtherCAT), provide access to the drive parameter in EtherCAT.

MOVITOOLS® MotionStudio can access all unit functions via VoE services (Vendor-specific over EtherCAT).

6.2.1 SDO services READ and WRITE

Depending on the EtherCAT master or the configuration environment, the user interface is represented differently. In each case, however, the following data is required for executing the SDO command.

SDO-READ	Description
Slave address (16 bit)	EtherCAT address of the servo inverter from which the data is to be read.
Index (16 bit) Subindex (8 bit)	Address in the object dictionary from which the data is to be read.
Data Data length	Structure for storing the received data and its length.

SDO-WRITE	Description
Slave address (16 bit)	EtherCAT address of the servo inverter to which the data is to be written.
Index (16 bit) Subindex (8 bit)	Address in the object dictionary to which the data is to be written.
Data Data length	Structure in which the data to be written is stored.

For the SDO services READ and WRITE, other flags and parameters might be necessary:

- For activating the function
- For In-progress message or error message
- For timeout monitoring
- For reporting errors during the execution

6.2.2 Reading a parameter via TwinCAT (example)

The function "SDO-READ" is available for reading a parameter. The index of the parameter to be read is necessary.

For implementation in TwinCAT, the function module *FB_EcCoESdoRead* is required. This function module is available in the *TcEtherCAT.lib* library. You can integrate this function module in two steps.

1. Creating an instance of the function module *FB_EcCoESdoREAD*.
2. The inputs of the function module are assigned as follows:
   - sNetID: Specification of the Net-ID of the EtherCAT master.
   - nSlaveAddr: EtherCAT address of the SEW unit from which the data is read.
   - nIndex: Index of the parameter to be read.
   - nSubIndex: Subindex of the parameter to be read.
   - pDstBuf: Pointer to the data range in which the read parameters are to be stored.
   - cbBufLen: Maximum memory size for parameters to be read in byte.
   - bExecute: A positive edge starts the read process.
   - tTimeout: Timeout interval of the function module.

The output flags *bBusy* and *bError* indicate the state of the service, *nErrId* the error number when flag *bError* is set, if applicable.

You can display information about the index and the subindex of the parameter to be read in the parameter tree by moving the cursor over the respective parameter. The information is then displayed as a tool tip.

The function module is integrated in TwinCAT as follows:

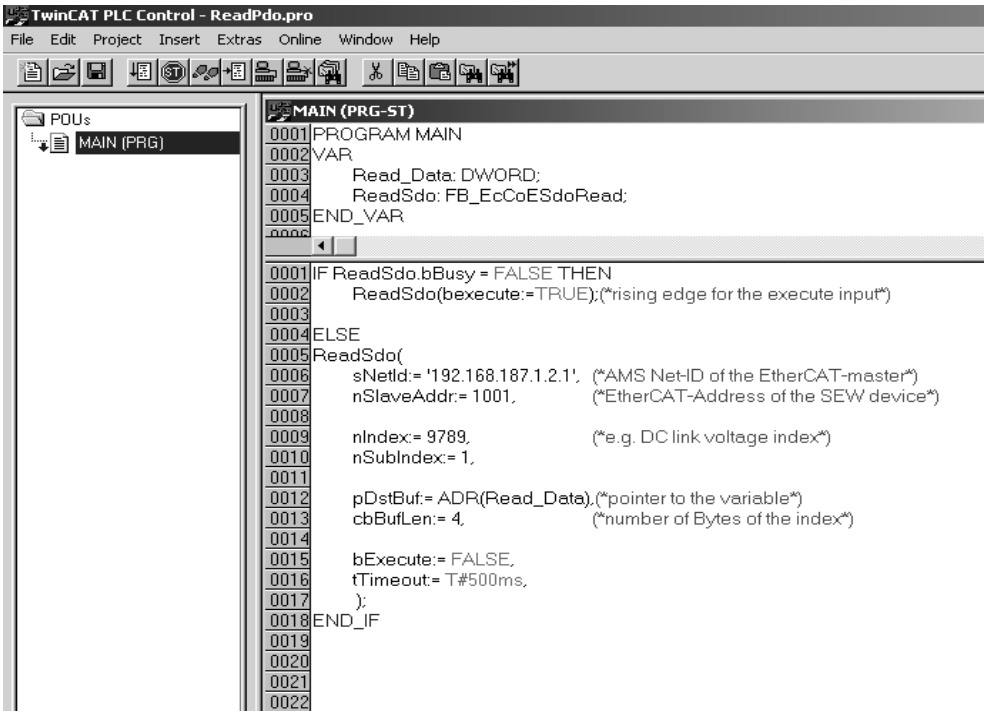

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Figure 12: Integration of the function module in TwinCAT

In the above example, the DC link voltage was read off (9789.1). The number 610000 is received, for example, which corresponds to a voltage of 610 V according to the MOVIAXIS® parameter description.

6.2.3 Writing a parameter via TwinCAT (example)

The function "SDO-WRITE" is available for writing a parameter. The index of the parameter to be written is necessary.

For implementation in TwinCAT, the function module *FB_EcCoESdoWrite* is required. This function module is available in the *TcEtherCAT.lib* library. You can integrate this function module in two steps.

1. Creating an instance of the function module *FB_EcCoESdoWrite*.
2. The inputs of the function module are assigned as follows:
   - sNetID: Specification of the Net-ID of the EtherCAT master.
   - nSlaveAddr: EtherCAT address of the SEW unit from which the data is read.
   - nIndex: Index of the parameter to be read.
   - nSubIndex: Subindex of the parameter to be read.
   - pDstBuf: Pointer to the data range in which the read parameters are to be stored.
   - cbBufLen: Maximum memory size for parameters to be read in byte.
   - bExecute: A positive edge starts the read process.
   - tTimeout: Timeout interval of the function module.

The output flags *bBusy* and *bError* indicate the state of the service, *nErrId* the error number when flag *bError* is set, if applicable.

You can display the index and the subindex of the parameter to be read in the parameter tree by moving the cursor over the respective parameter. The information is then displayed as a tool tip.

The function module is integrated in TwinCAT as follows:

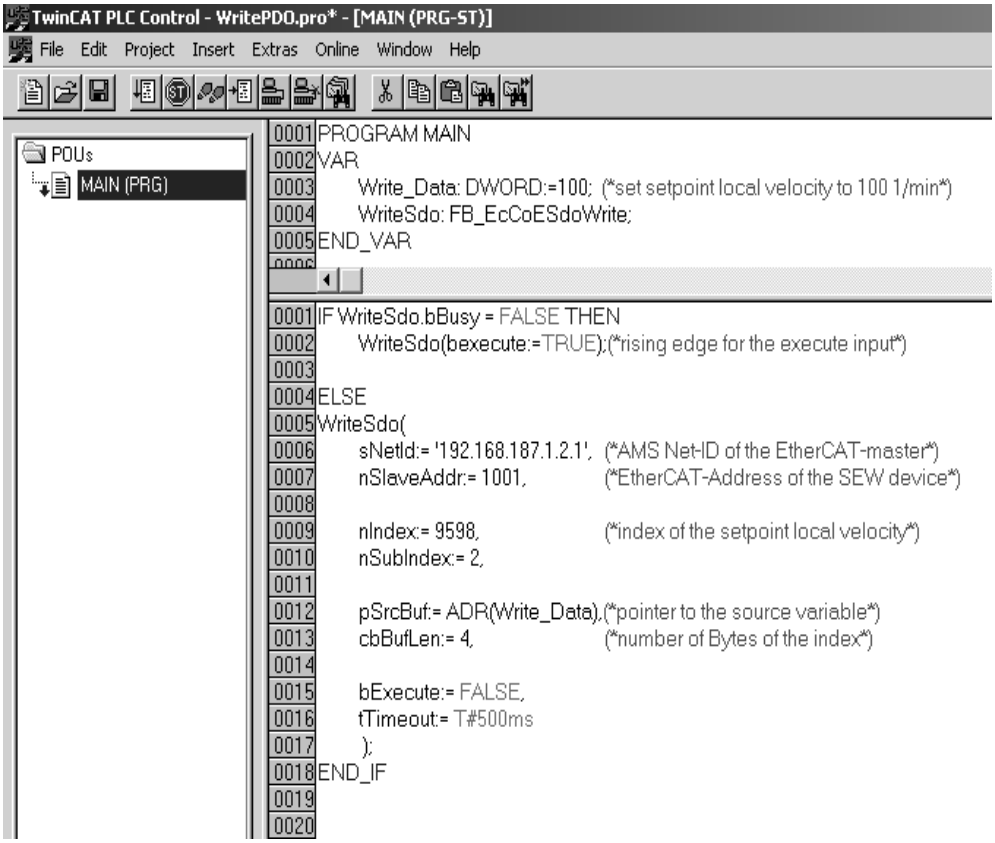

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Figure 13: Integration of the function module in TwinCAT

SEW parameter always have a data length of 4 Byte (1DWord). For scaling and a more detailed description, refer to the "MOVIAXIS®Project Planning Manual".

In the above example, the "Local speed" setpoint (9598.2) is set to a speed of 100 1/min.

6.3 Configuration return codes

6.3.1 Elements

In the event of an incorrect parameter setting, the servo drive sends back various return codes to the master which sets the parameters. These codes provide detailed information about what caused the error. Generally, these return codes are structured according to the following elements.

- Error class
- Error code
- Additional code

6.3.2 Error class

The error class element (1 byte) provides a more exact classification of the error type.

Class (hex)	Designation	Meaning
1	vfd state	Status error of the virtual field device
2	application reference	Error in application program
3	definition	Definition error
4	resource	Resource error
5	service	Error during execution of service
6	access	Access error
7	ov	Error in the object list
8	other	Other error

6.3.3 Error code

The error code element (1 Byte) allows for a more detailed identification of the error cause within the error class. For *Error class 8 = Other error*, only *Error code = 0 (Other error code)* is defined. In this case, detailed identification is made using the *additional code*.

6.3.4 Additional code

The additional code (2 bytes) includes the detailed error description.

6.3.5 List of implemented error codes for SDO services

Error code	Error class	Error code	Additional code	Designation	Description
0x00000000	0	0	0	NO_ERROR	No error.
0x05030000	5	3	0	TOGGLE_BIT_NOT_CHANGED	Error in the toggle bit during segmented transfer.
0x05040000	5	4	0	SDO_PROTOCOL_TIMEOUT	Timeout during execution of service.
0x05040001	5	4	1	COMMAND_SPECIFIER_UNKNOWN	Unknown SDO service.
0x05040005	5	4	5	OUT_OF_MEMORY	Memory overflow during execution of SDO service.
0x06010000	6	1	0	UNSUPPORTED_ACCESS	Unauthorized access to an index.
0x06010001	6	1	1	WRITE_ONLY_ENTRY	Index may only be written to, but not be read.
0x06010002	6	1	2	READ_ONLY_ENTRY	Index may only be read, but not be written to; parameter lock active.
0x06020000	6	2	0	OBJECT_NOT_EXISTING	Object does not exist, incorrect index. Option card for this index does not exist.
0x06040041	6	4	41	OBJECT_CANT_BE_PDOMAPPED	Index may not be mapped into a PDO.
0x06040042	6	4	42	MAPPED_OBJECTS_EXCEED_PDO	Number of mapped objects is to large for PDO.
0x06040043	6	4	43	PARAM_IS_INCOMPATIBLE	Data format is not compatible with index.
0x06040047	6	4	47	INTERNAL_DEVICE_INCOMPATIBILITY	Internal unit error.
0x06060000	6	6	0	HARDWARE ERROR	Internal unit error.
0x06070010	6	7	10	PARAM_LENGTH_ERROR	Data format for index is the wrong size.
0x06070012	6	7	12	PARAM_LENGTH_TOO_LONG	Data format for index is too large.
0x06070013	6	7	13	PARAM_LENGTH_TOO_SHORT	Data format for index is too small.
0x06090011	6	9	11	SUBINDEX_NOT_EXISTING	Subindex not implemented.
0x06090030	6	9	30	VALUE_EXCEEDED	Value invalid.
0x06090031	6	9	31	VALUE_TOO_GREAT	Value too high
0x06090032	6	9	32	VALUE_TOO_SMALL	Value too low
0x06090036	6	9	36	MAX_VALUE_IS_LESS_THAN_MIN_VALUE	Maximum limit for the value is smaller than the minimum limit
0x08000000	8	0	0	GENERAL_ERROR	General error
0x08000020	8	0	20	DATA_CANNOT_BE_READ_OR_STORED	Access error to data
0x08000021	8	0	21	DATA_CANNOT_BE_READ_OR_STORED_BECAUSE_OF_LOCAL_CONTROL	Data access error due to local control.
0x08000022	8	0	22	DATA_CANNOT_BE_READ_OR_STORED_IN_THIS_STATE	Data access error due to unit status.
0x08000023	8	0	23	NO_OBJECT_DICTIONARY_IS_PRESENT	No object dictionary is present.

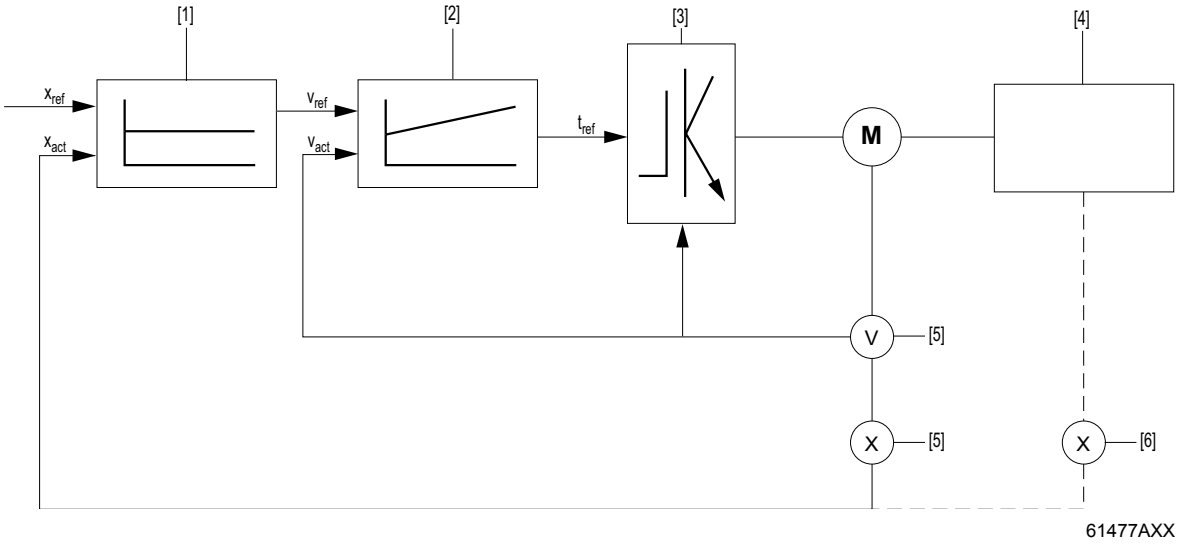
7 Motion Control via EtherCAT

This chapter contains information about the EtherCAT functions that enable clock synchronous operation of MOVIAXIS® connected to an EtherCAT master, which is necessary for motion control applications.

7.1 EtherCAT introduction

This section describes the functions and terms used for clock synchronous operation of SEW servo inverters on EtherCAT. Comprehensive, detailed technical information about EtherCAT is available from the EtherCAT user organization, e.g. at www.EtherCAT.org, and from the manufacturers of EtherCAT master systems.

Based on the cascade control common in drive technology, the principal mechanisms for motion control applications are described here.



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x_{ref}	Position setpoint	[1]	Position controller
x_{act}	Position actual value	[2]	Speed controller
v_{ref}	Speed setpoint	[3]	Output stage of the servo inverter
v_{act}	Actual speed value	[4]	Driven machine (load)
t_{ref}	Torque setpoint	[5]	Encoder (V = speed; X = position)
		[6]	Optional encoder

A position setpoint (x_{ref}) is the starting point. Using the position actual value (x_{act}), the position controller [1] calculates a speed setpoint (v_{ref}). The speed controller [2] uses speed setpoint and actual value to calculate the torque setpoint (t_{ref}), which generates a torque in the motor supplied by the servo inverter output stage [3]. Depending on the counter-torque caused by the driven machine [4], the motor runs with a certain speed (measured by encoder [5]). Depending on the motor speed, a position change occurs, which is detected by a position encoder [5] on the motor.

Depending on the application, the control loops for torque, speed or position can now be closed in the servo inverter or in the higher-level controller. MOVIAXIS® can take over all control loops including position control. In this case, positioning travel can only be performed when a setpoint position is transferred to the servo inverter (e.g. "Bus Positioning" application module). The current position and, once the positioning command has been executed, a "ready message" is sent to the controller.

In motion control applications, positioning travel with target position and travel parameters such as speed and ramp time is administered in the motion controller – that is usually the higher-level controller. From the calculated path curve, a setpoint speed (→ sec. "7.2.1") or setpoint position (→ sec. "7.2.2") is tranmitted to the servo inverter in short intervals. The servo inverter then sets this setpoint speed or position and reports the current position back. The motion controller knows by itself when the positioning command has been executed.

Since the higher-level controller transmits the setpoints cyclically, the acceleration and deceleration ramps are also calculated in this controller. No ramp function integrated into the drive is used here.

Clock synchronism

For each control cycle, the controller reads in the position actual value and calculates the current speed (dx/dt) and probably other information such as acceleration, jerk, etc, from the position difference (dx) and the time difference (dt) of the previous control interval.

The time slices of the controller, the bus transmission and the internal processing cycle of the servo inverter and of external encoders, if applicable, must be synchronized to one another.

Example

This example is to demonstrate how aliasing effects can occur if controller, bus, servo inverter or encoder are not clock-synchronous (→ following figure).

- Control time slice of the controller: 5 ms
- Bus clock pulse: 5 ms, synchronous to the controller
- Processing time in the servo inverter: 5 ms, not synchronous

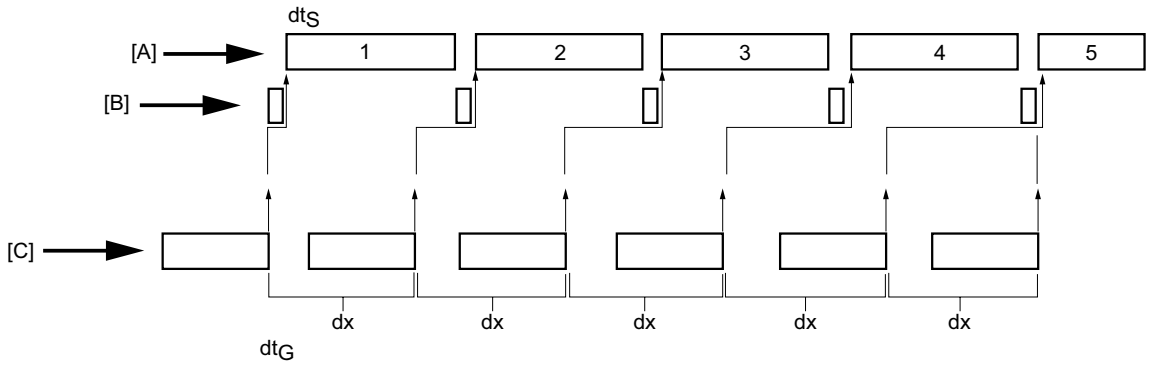

Figure 14: Creation of aliasing effects

[A]	Control interval dt_S	[C]	Time slice of servo inverter or encoder dt_G
[B]	Bus cycle	dx	Position difference (covered distance)

Since in this example, the servo inverter or encoder and the controller are not synchronized, the time slices will slowly drift apart because their quartz oscillators are not ideal. This can lead to jumps in the transmitted position value.

While in control intervals 1 to 3 only a slightly inaccurate speed ($v = dx/dt_S \approx dx/dt_G$) is determined, in the fourth control interval, a significant error (v = 2dx/dtS) occurs when calculating the velocity. This incorrect speed calculated in one sample interval results in violent responses of the control algorithms in the controller and can even trigger error messages.

The problem described above caused by discreet sampling in different systems will usually only be a problem in motion control applications when the cycle time of the controller is short or similar to the internal processing cycles of the servo inverter and external encoders.

As a rule, EtherCAT is designed for bus and control cycles to be synchronous.

The *Distributed Clock* mechanism also enables synchronization of the internal processing time slice of the servo inverter.

In MOVIAXIS®, the synchronization of time slices and the data transfer is controlled via the dual-port RAM of the XFE24A option.

7.1.1 Speed setpoint interface (Velocity mode)

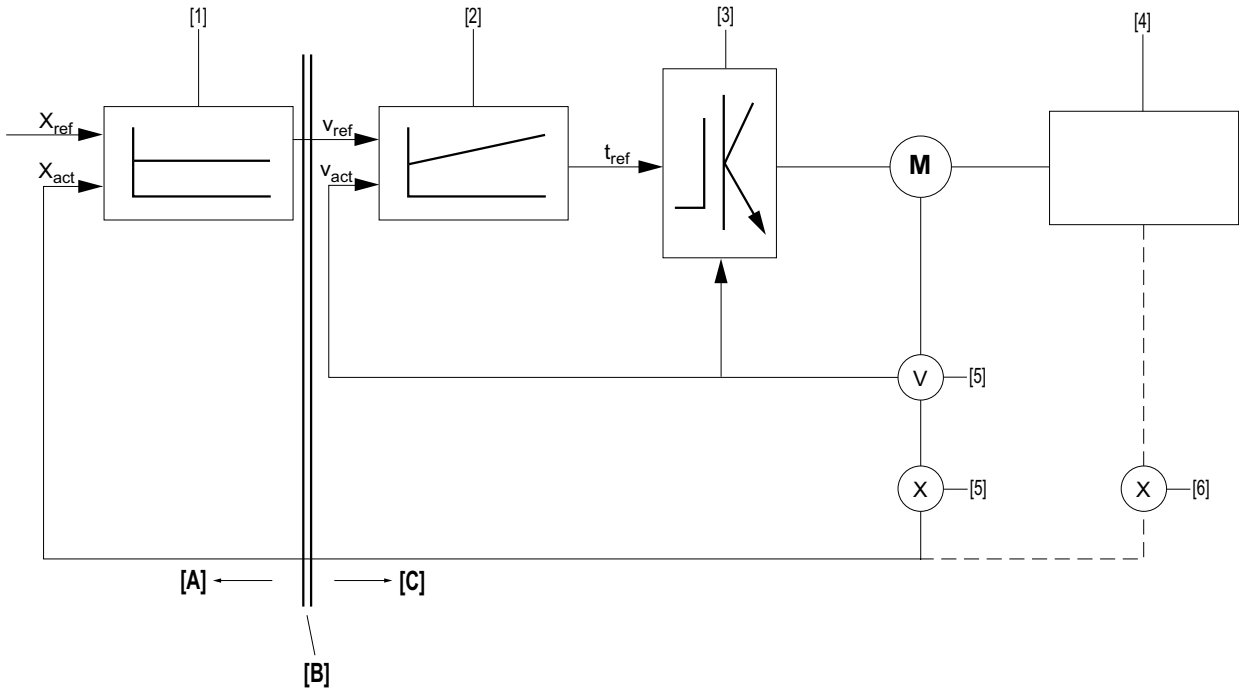

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Figure 15: Velocity mode – Cascade with fieldbus interface

[A]	Control	[B]	Fieldbus interface	[C]	Servo inverter

x_{ref}	Position setpoint	[1]	Position controller
x_{act}	Position actual value	[2]	Speed controller
v_{ref}	Speed setpoint	[3]	Output stage of the servo inverter
v_{act}	Actual speed value	[4]	Driven machine
t_{ref}	Torque setpoint	[5]	Encoder (V = speed; X = position)
		[6]	Optional encoder

In Velocity mode, the controller transmits a speed (or velocity) setpoint to the servo inverter. The position actual value is read by the servo inverter or a separate encoder.

In Velocity mode, the servo inverter is a simple speed control element. The time slices of the controller, the bus transmission and the internal processing cycle of the servo inverter and of external encoders, if applicable, must be synchronized to one another.

Referencing of the position, monitoring of permitted travel ranges or limit switches, load-dependent ramp specification and lag error monitoring are realized in the higher-level controller and are not tasks of MOVIAXIS®.

To prevent unwanted, high acceleration values for larger control intervals (>1 ms), the speed setpoint is not directly adopted by MOVIAXIS®, but interpolated linearly. This means for a setpoint cycle of 5 ms that the controller sets the required speed change in the MOVIAXIS® not every 5 ms as one large step, but rather as 5 small steps of 0.5 ms.

7.1.2 Settings for Velocity mode (speed interface)

IN process data

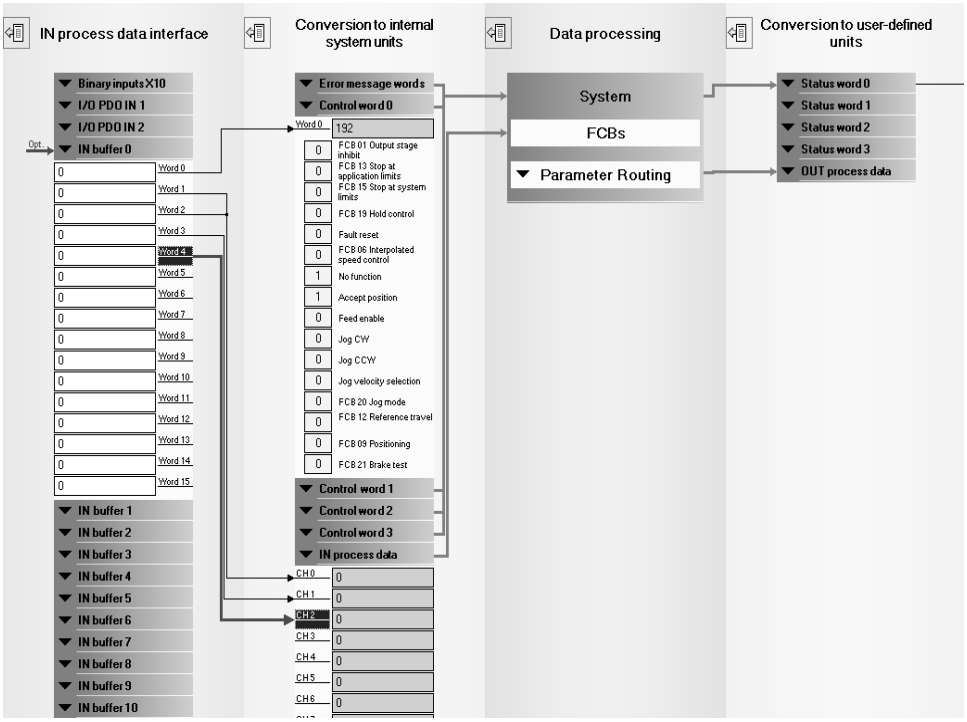

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Figure 16: IN process data

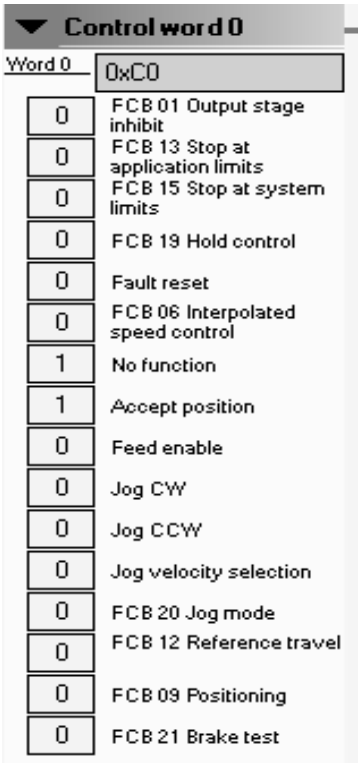

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Figure 17: Control word 0 settings

IN buffer 0 links

Then establish links from the IN buffer 0 to the control word 0 and to the process data according the above example using drag & drop.

Control word 0 settings

For calling up the FCB06 interpolated speed control, it must be configured in a control word (here: control word 0).

Make the sample settings in control word 0 according to Figure 17 .

IN process data settings

Set the IN process data according to the following figure.

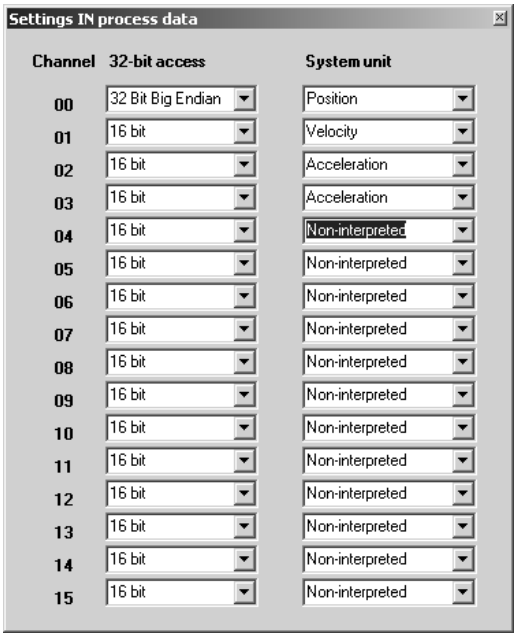

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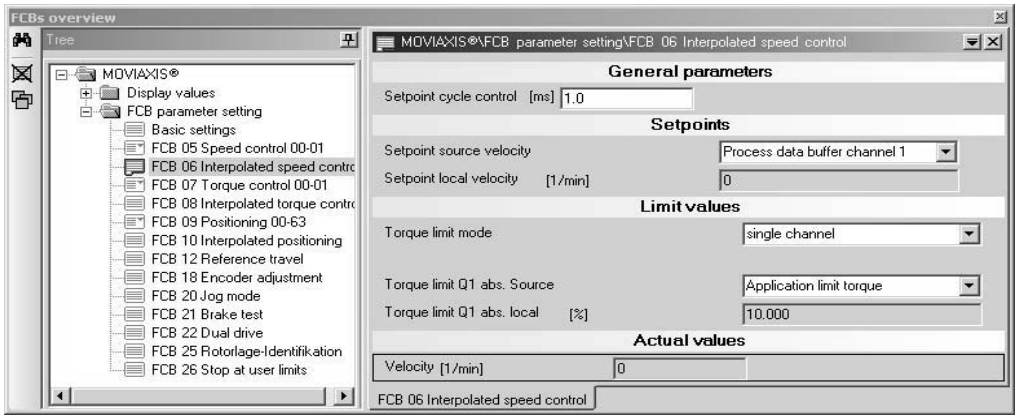
Figure 18: IN process data settings

Configuration of the FCB06 (interpolated speed)



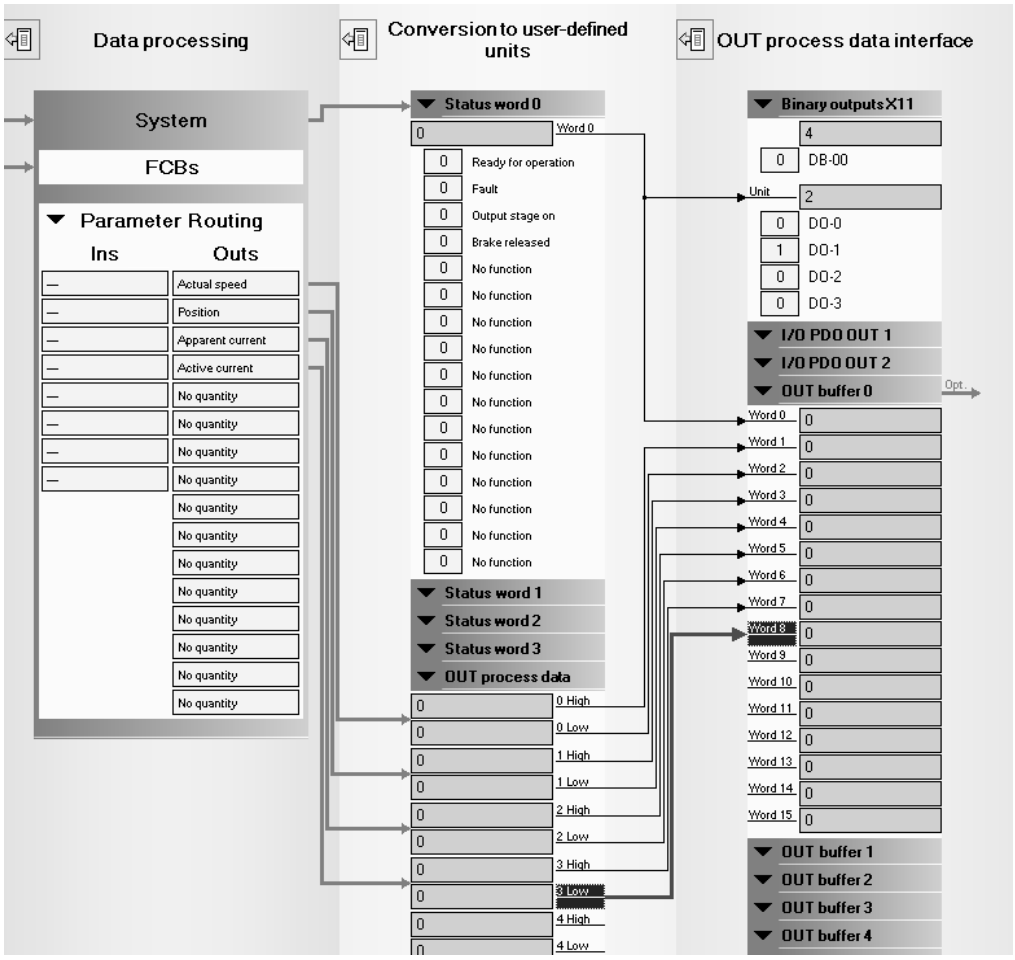
11665AXX

Figure 19: Configuration of the FCB06

Set the cycle time of your EtherCAT controller in the controller setpoint cycle parameter, e.g. 1 ms.

In addition to that, the source for the speed setpoint must be set, here: process data buffer channel 1.

OUT process data



11666AXX

Figure 20: OUT process data

The unit and resolution of the speed or velocity and position, or travel of the axis, depends on the settings of the user travel units, which were made during startup. If no other user travel units were defined, they are as follows:

Travel distance: 1.0000 [Revolutions]

Velocity: 1 [1/min]

The settings of status word 0, control word 1 and process output data correspond to the factory setting.

OUT buffer 0 links

Then establish links from status word 0 and OUT process data to the Out buffer 0 using drag & drop.

7.1.3 Position setpoint interface (Position mode)

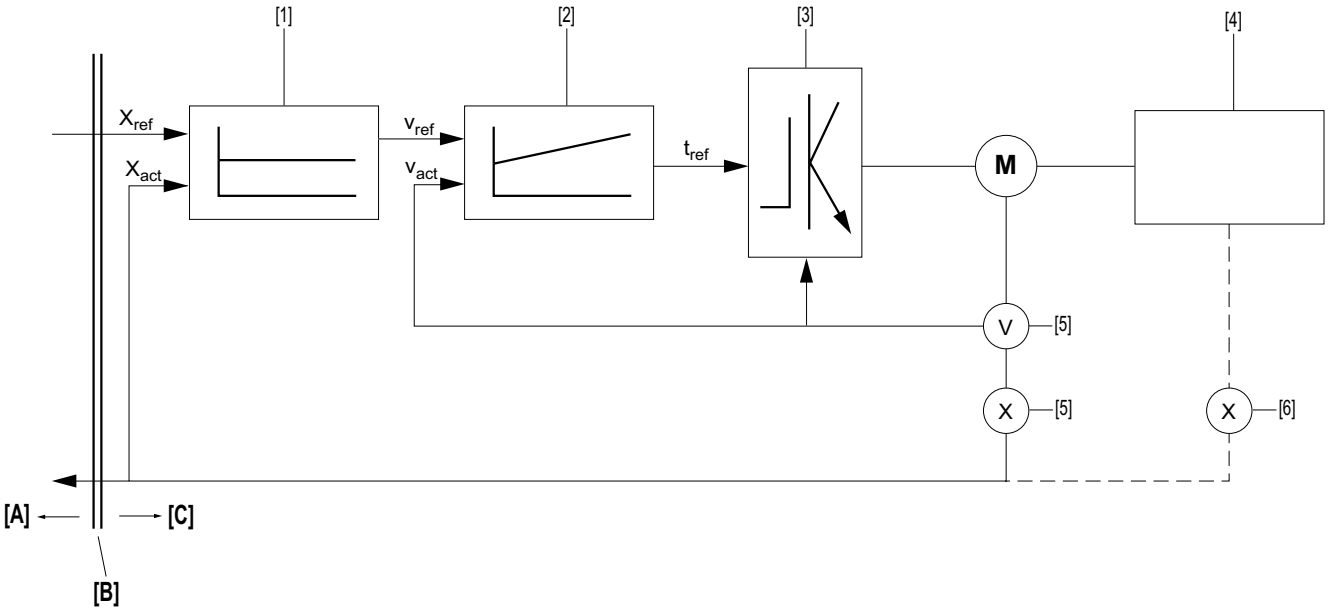


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Figure 21: Position mode – Cascade with bus interface

[A]	Control	[B]	Fieldbus interface	[C]	Servo inverter

x_{ref}	Position setpoint	[1]	Position controller
x_{act}	Position actual value	[2]	Speed controller
v_{ref}	Speed setpoint	[3]	Output stage of the servo inverter
v_{act}	Actual speed value	[4]	Driven machine
t_{ref}	Torque setpoint	[5]	Encoder (V = speed; X = position)
		[6]	Optional encoder

In Position mode, the controller transmits a position setpoint cyclically to the servo inverter. The position actual value is read back by the servo inverter or a separate encoder.

In Position mode, the servo inverter follows the constantly changing position setpoint and generates the required speed setpoint for the speed controller [2] from the position actual value (from [5] or [6]). The time slices of the controller, the bus transmission and the internal processing cycles of the servo inverter and of external encoders, if applicable, must be synchronized to one another.

After the position in the controller has been referenced to the position in the servo inverter, the monitoring of permitted travel ranges or limit switches can be performed in the servo inverter. Whether the settings of a load-dependent ramp specification and lag error monitoring in the servo inverter make sense must then be checked in detail.

To prevent unwanted, high acceleration values for larger control intervals (>1 ms), the speed setpoint is not directly adopted by MOVIAXIS®, but interpolated linearly. This means for a setpoint cycle of 5 ms that the controller sets the required position change in the MOVIAXIS® not every 5ms as one large step, but rather as 5 small steps of 0.5ms.

7.1.4 Settings for Position mode

IN process data

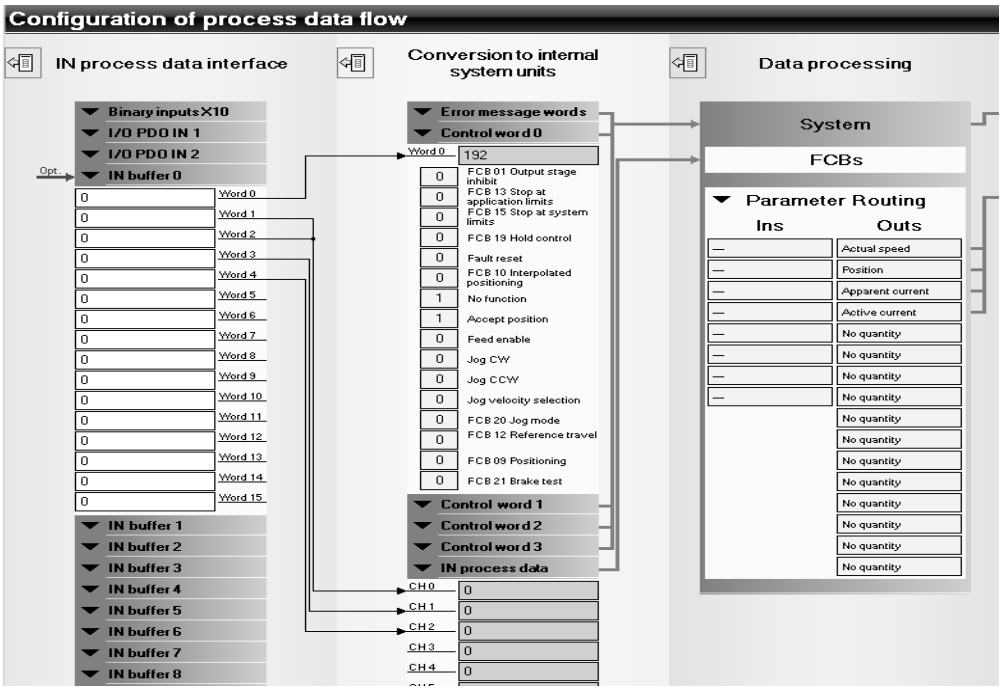

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Figure 22: IN process data

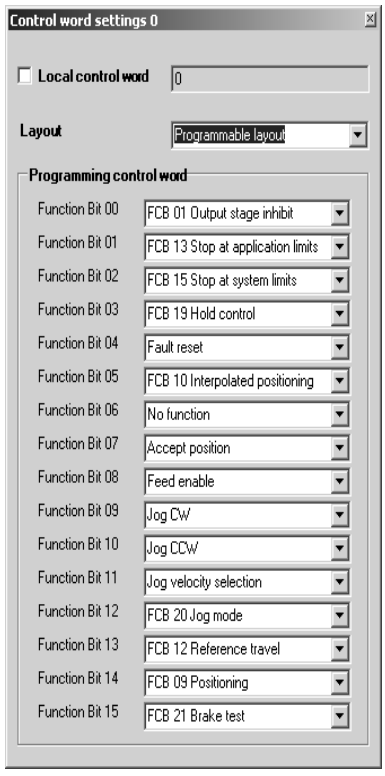

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Figure 23: Control word 0 settings

IN buffer 0 links

Establish a connection from status word 0 and IN process data to the IN buffer 0 using drag & drop.

The assignment of control word 0 differs from the process data link for Velocity mode.

Control word 0 settings

For calling up the FCB10 interpolated positioning, it must be configured in a control word (here: control word 0).

Make the sample settings in control word 0 according to Figure 23 .

IN process data settings

Set the IN process data according to the following figure.

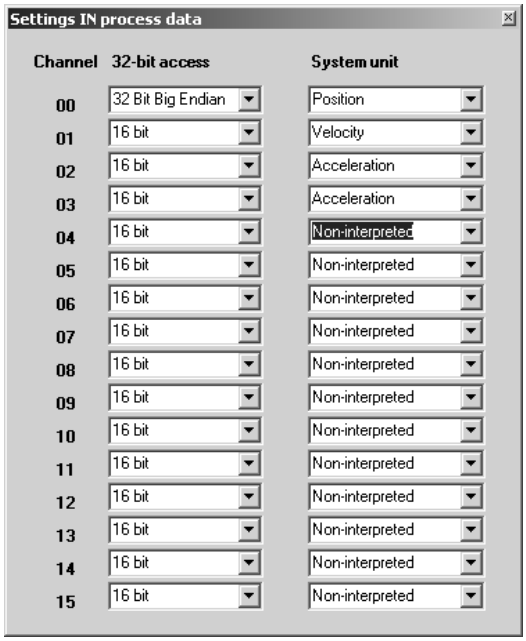

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Figure 24: IN process data settings

Configuration of the FCB10 (interpolated positioning)

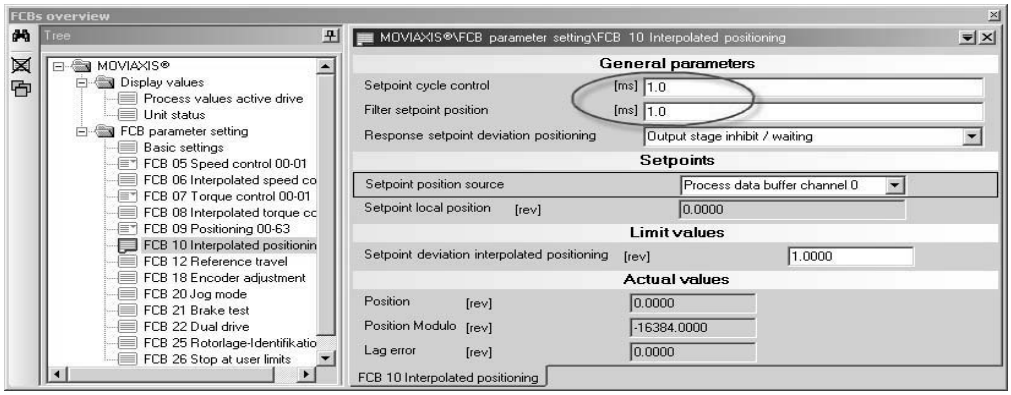

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Figure 25: Configuration of the FCB10

Set the cycle time of your EtherCAT controller in the controller setpoint cycle parameter, e.g. 1 ms.

The position setpoints of the controller are smoothed with these configurable mean value filters for a "steady", continuous speed curve.

In addition to that, the source for the position setpoint must be set, here: process data buffer channel 0.

OUT process data

The configuration of the OUT process data is identical to the configuration of the Velocity mode, more information is available there.

The unit and resolution of the speed or velocity and position, or travel of the axis, depends on the settings of the user travel units, which were made during startup. If no other user travel units were defined, they are as follows:

Travel distance: 1.0000 [Revolutions]

Velocity: 1 [1/min]

7.2 Settings in the EtherCAT master

For time slice synchronization, you must activate the function *Distributed Clock*. The bus cycle of the MOVIAXIS® must correspond exactly to that of the external controller, which was set during startup. Please also check the watchdog for timeout monitoring only for sync manager 0x1000 (output data). The watchdog for timeout monitoring is set to a default value.

7.2.1 Settings for Velocity mode

- The speed setpoint is transferred via the input word configured in the PDO Editor.
- The position is transferred via the output word configured in the PDO Editor. The resolution is set during startup.

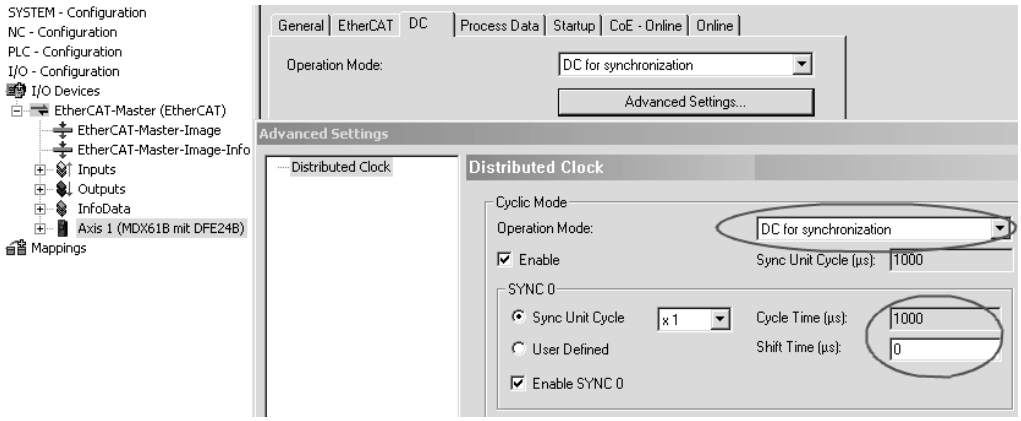
7.2.2 Settings for Position mode

- The position setpoint is transferred via the input word configured in the PDO Editor.
- The position is transferred via the output word configured in the PDO Editor. The resolution is set during startup.

7.3 Example: TwinCAT

Configuring clock synchronous operation

Make the settings shown in the following figures.



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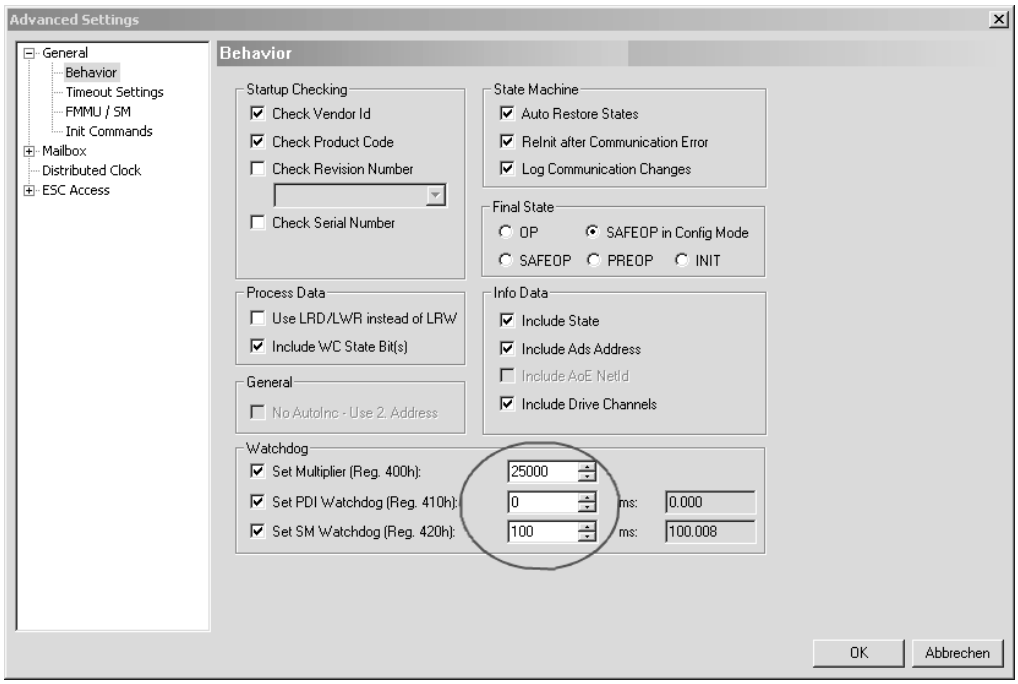
For clock synchronous operation, select the "DC for synchronization" option on the DC (Distributed Clock) tab page. Make sure that the cycle time in the "Cycle time" field matches exactly the synchronization time set in parameter 9963.1.

Please check the settings of the watchdog.

Possible times for "Distributed Clock": 500 µs, 1 ... 10ms.



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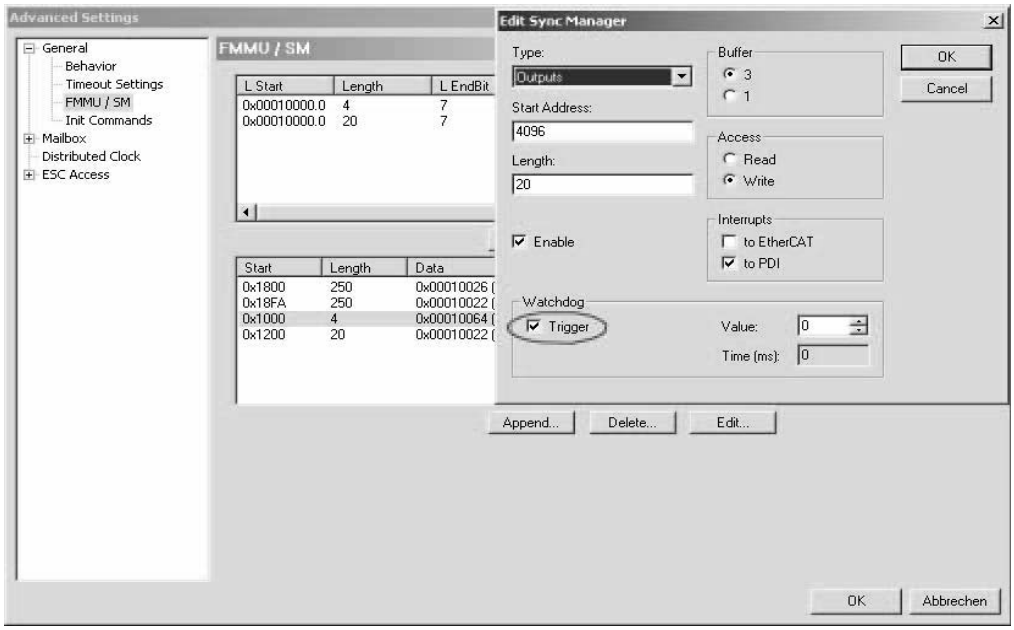
Check the timeout monitoring for the sync manager 0x1000. To do so, tick the "Watchdog Trigger" option in the "Edit Sync Manager" window (→ following figure) and enter the watchdog time in the "Value" field.



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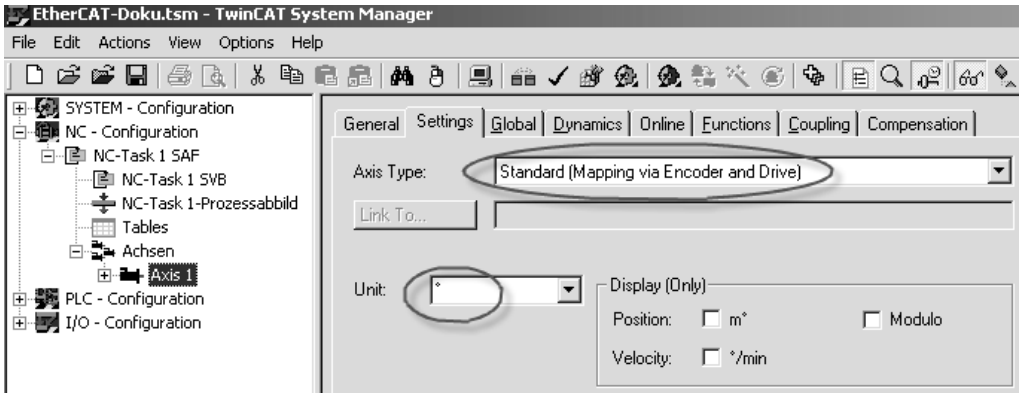
NC axis configuration

Then, the NC axis is configured (→ following figure).



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On the "Settings" tab page, select the "Standard" option in the "Axis Type" field and the system unit (e.g. °) in the "Unit" field.

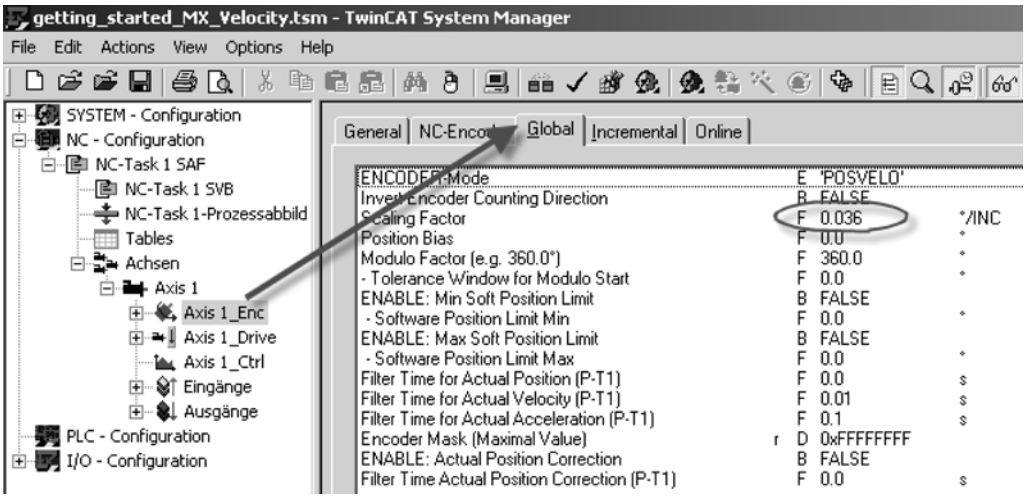
Set the maximum speed and the lag error monitoring on the "Global" tab page.

Set the ramp times on the "Dynamics" tab page.

The settings must match the mechanical structure and the corresponding settings in the servo inverter.

Encoder configuration

The CANopen DS402" is specified as encoder (under "Axis x_Enc") and configured as follows (→ following figure).



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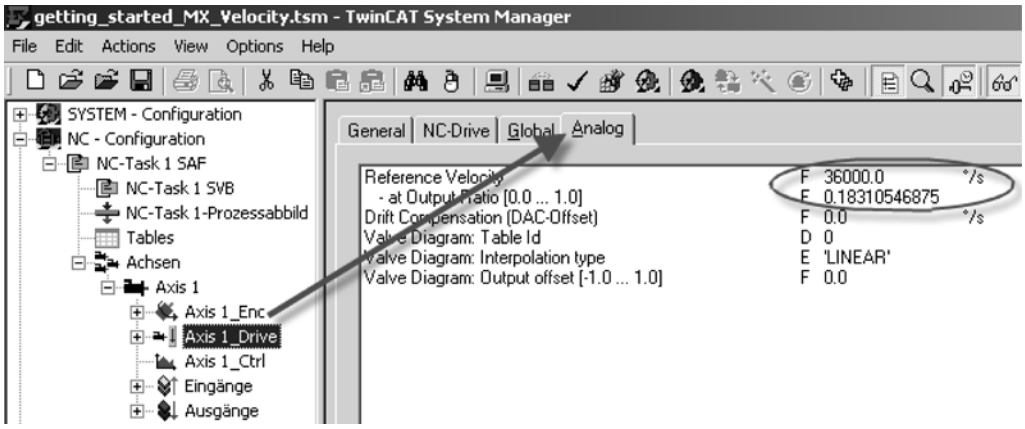
The scaling factor results from the following formula:

$$\frac{360° \cdot PositionNumerator}{2^{16} Inc \cdot PositionDenominator}$$

7.3.1 Velocity mode

In Velocity mode, "Drive connected to KLXXX..." is selected (under "Axis x_Drive"). Enter the following values in the "Analog" tab page (→ following figure):



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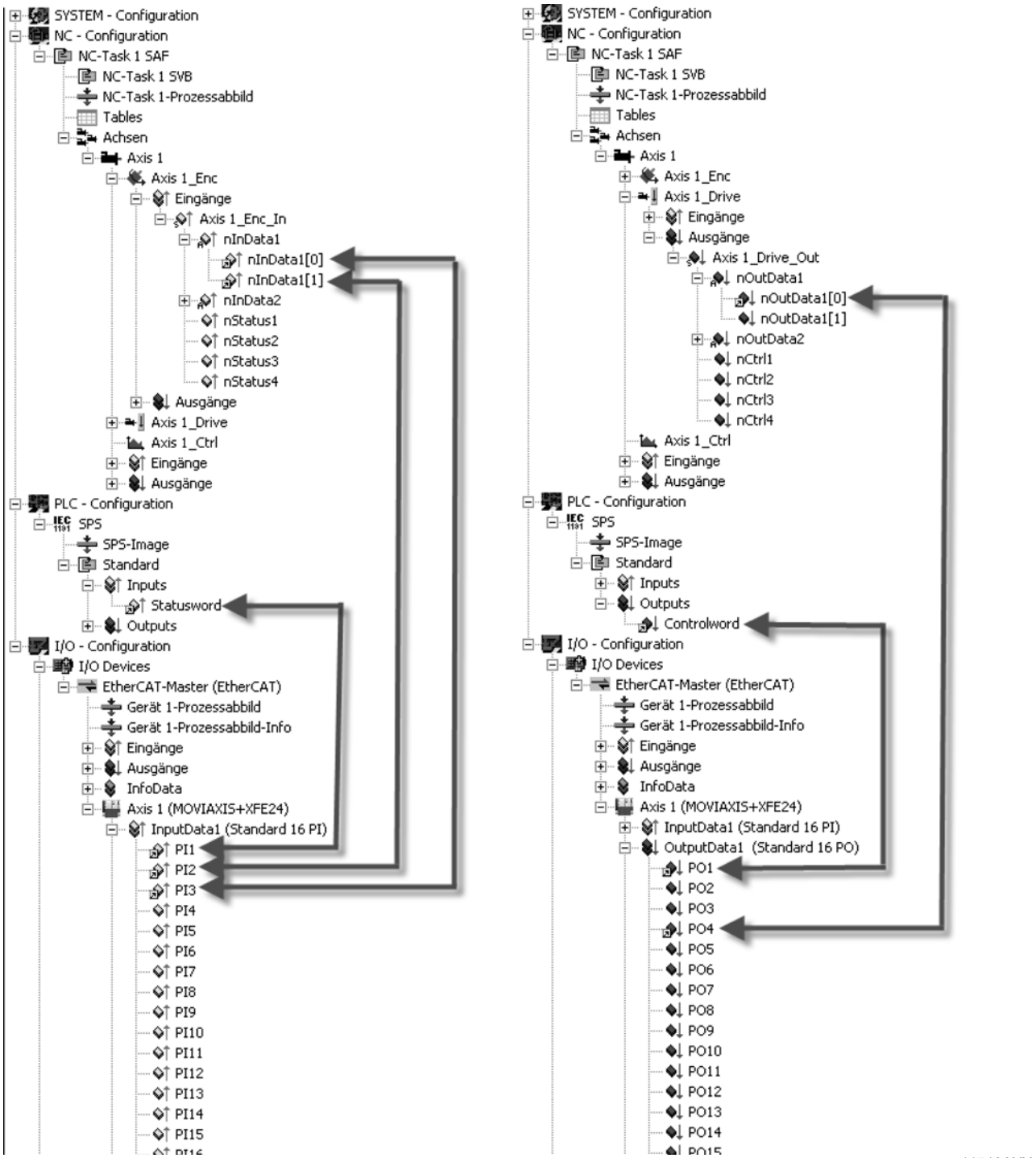
MOVIAXIS® factory settings for speed:

The setpoint speed ("Reference Velocity") = (maximum motor speed) × 6 is given with the conversion factor "at Output Ratio [0.0 ... 1.0]" = (maximum motor speed) / 2^{15}, depending on the scaling factor in MOVIAXIS®.

MOVIAXIS® user travel units and scaling factors that deviate from the factory setting must be adjusted accordingly using the conversions and factors stated above.

Finally, the setpoint speed and the actual position of the drive are linked to the NC axis. The control and status word 1 is controlled by teh PLC task according to the description in the MOVIAXIS® project planning manual (→ following figure).



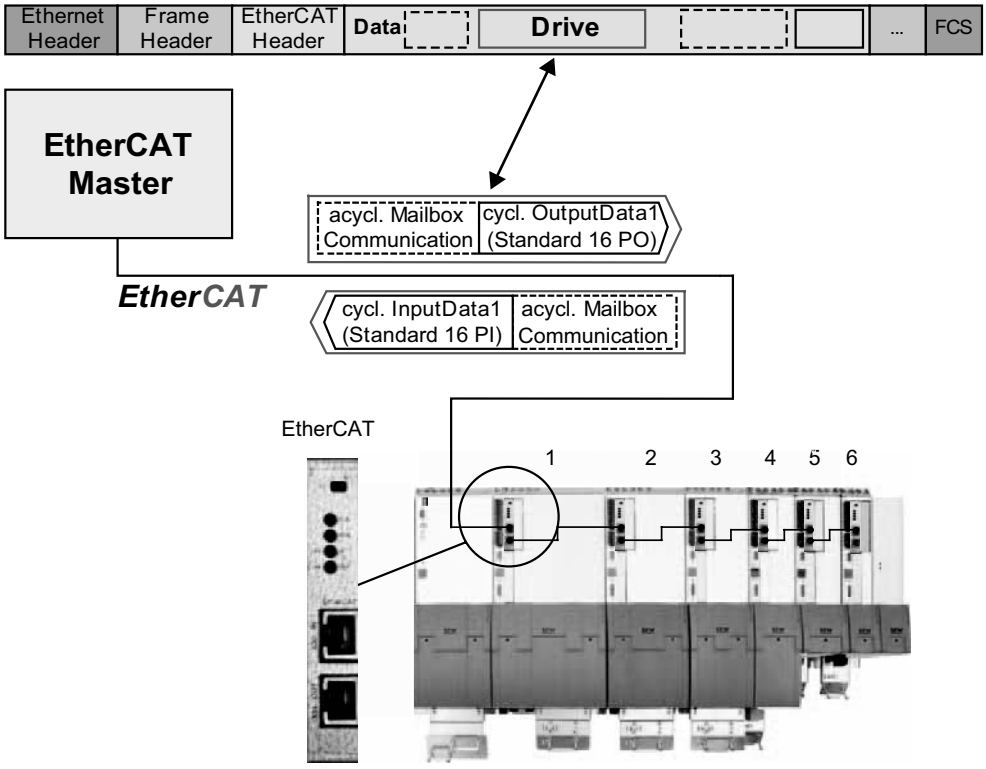
8 Operating MOVITOOLS® MotionStudio via EtherCAT

This section describes the operation of the MOVITOOLS® MotionStudio via EtherCAT.

8.1 Introduction

EtherCAT provides the user with acyclical parameter services in addition to cyclical process data. This acyclical data exchange is performed via the mailbox gateway of the EtherCAT master (→ following figure).

The parameter services of MOVITOOLS® MotionStudio are integrated into the EtherCAT telegrams via the mailbox gateway in the EtherCAT master. The feedback of the drives is transferred by the XFE24A in the same way to the mailbox gateway and further to MOVITOOLS® MotionStudio.



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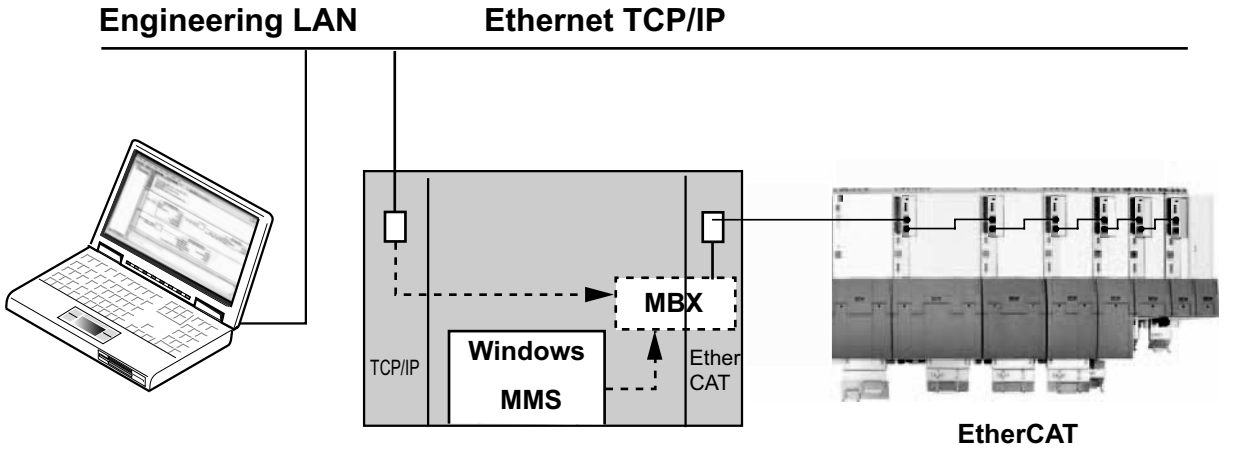
VoE (Vendor-specific over EtherCAT) is activated on the EtherCAT master and the EtherCAT mailbox is set up. A connection to the drive can then be established by means of VoE and MOVITOOLS® MotionStudio can be used online.

8.2 Required hardware

If a suitable operating system for MOVITOOLS® MotionStudio is installed in the EtherCAT controller, no further hardware is required.

If no suitable operating system is available or if MOVITOOLS® MotionStudio is to be operated from a different PC, the EtherCAT master requires a second Ethernet interface which is connected via LAN to the PC on which MOVITOOLS® MotionStudio is installed (→ following figure).



MBX Mailbox gateway

MMS MOVITOOLS® MotionStudio

8.3 Required software

MOVITOOLS® MotionStudio version 5.40. and higher

8.4 Installation

Install MOVITOOLS® MotionStudio according to the "MOVITOOLS® MotionStudio" manual.

8.5 Configuration of the mailbox gateway

- Activate the VoE / EoE support of the EtherCAT controller.
- Determine the IP address of the EtherCAT mailbox gateway. Usually the IP address is assigned by the TwinCAT program. It should not be changed.

In the TwinCAT program of Beckhoff, the above settings look as follows:

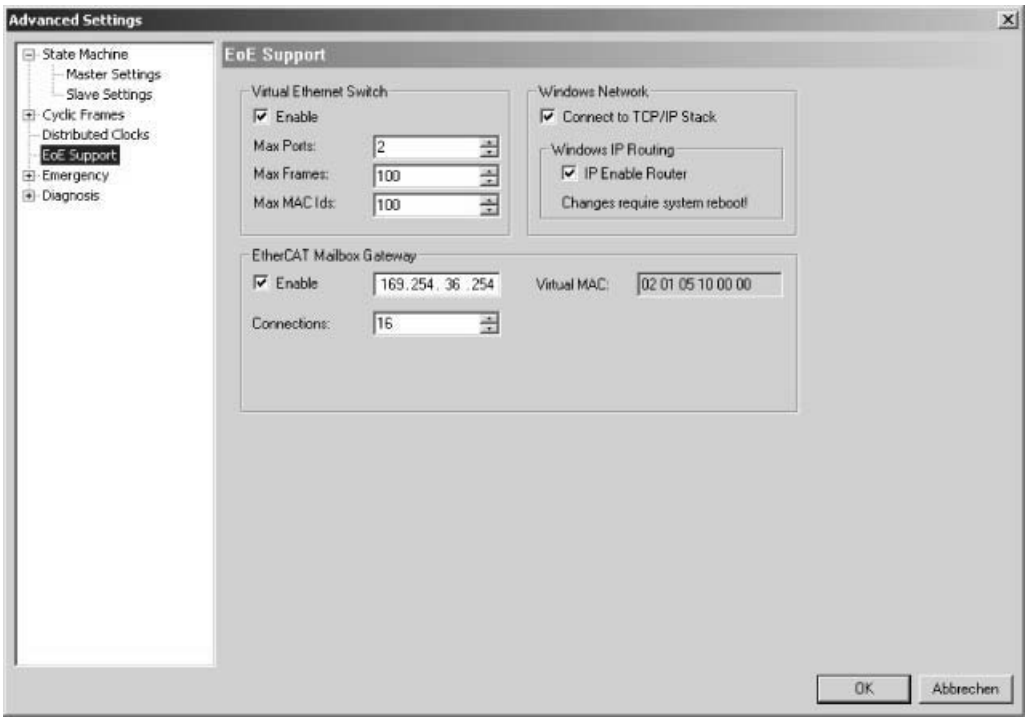


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Figure 26: Setting the IP address for the EtherCAT mailbox gateway

8.6 Network settings on the engineering PC

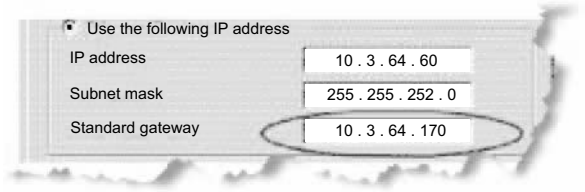
If MOVITOOLS® MotionStudio runs on the EtherCAT master, no network settings need to be made.

If the EtherCAT master is connected to an Ethernet network, PCs in the same subnet can use MOVITOOLS® MotionStudio for accessing SEW drives on the EtherCAT (→sec. "8.2"). For this purpose, the telegrams from the engineering PC are forwarded via the Ethernet interface of the EtherCAT master to the mailbox gateway (so-called routing).

There are **two basic routing variants**:

1. Variant: Access to the mailbox gateway by determining the standard gateway on the engineering PC. In this variant, the IP address of the EtherCAT master is specified as standard gateway.

   Select [Start] / [Settings] / [Network and dial-up connections]. The "Network and dial-up connections" window opens. Right-click on a LAN connection and select "Properties" from the context menu. The "LAN connection properties" window opens. Tick the "Internet protocol (TCP/IP)" checkbox in the selection window. Click on the"Properties" button. The "Properties - TCP connection/" window will open. Tick the "Use this IP address" checkbox and enter the following (→ following figure):



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2. Variant: Defining a static route.

   In this variant, an entry is added to the routing table of the engineering PC which will forward the engineering data via the EtherCAT master to the mailbox gateway.

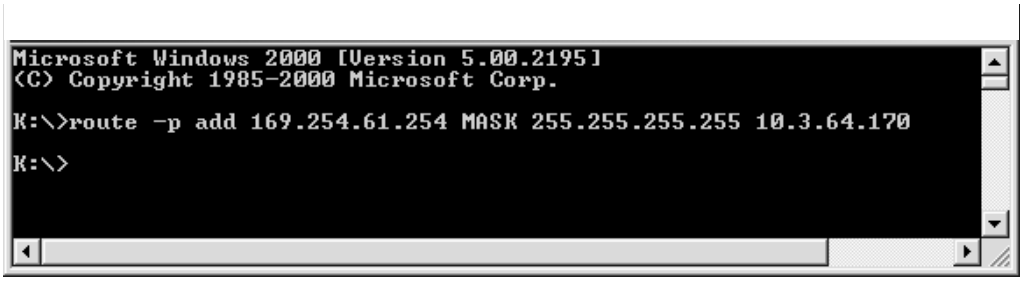
   The command for creating a static route in the DOS box is:

   route –p add [Target] MASK [Netmask] [Gateway]

   [Target]: Corresponds to the IP address of the EtherCAT mailbox gateway

   [Netmask]: Is usually set to 255.255.255.255 (host routing)

   [Gateway]: Corresponds to the IP address of the EtherCAT master in the TCP/IP network



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8.7 Configuration of the SEW communication server

For using MOVITOOLS® MotionStudio via EtherCAT, you have to configure the SEW communication server first.

8.7.1 Establishing communication

MOVITOOLS® MotionStudio allows you to communicate with the electronics products from SEW-EURODRIVE GmbH & Co KG via several, different communication paths at the same time.

When you start MOVITOOLS® MotionStudio, the SEW communication server is also started, and an additional icon will appear in the Windows status bar. .

8.7.2 Procedure

4 steps are involved in configuring the communication:

1. Open the settings window of the SEW communication server by clicking on the "Communication connection" icon in the toolbar (→ following figure) or via the "Network communication connections" menu.

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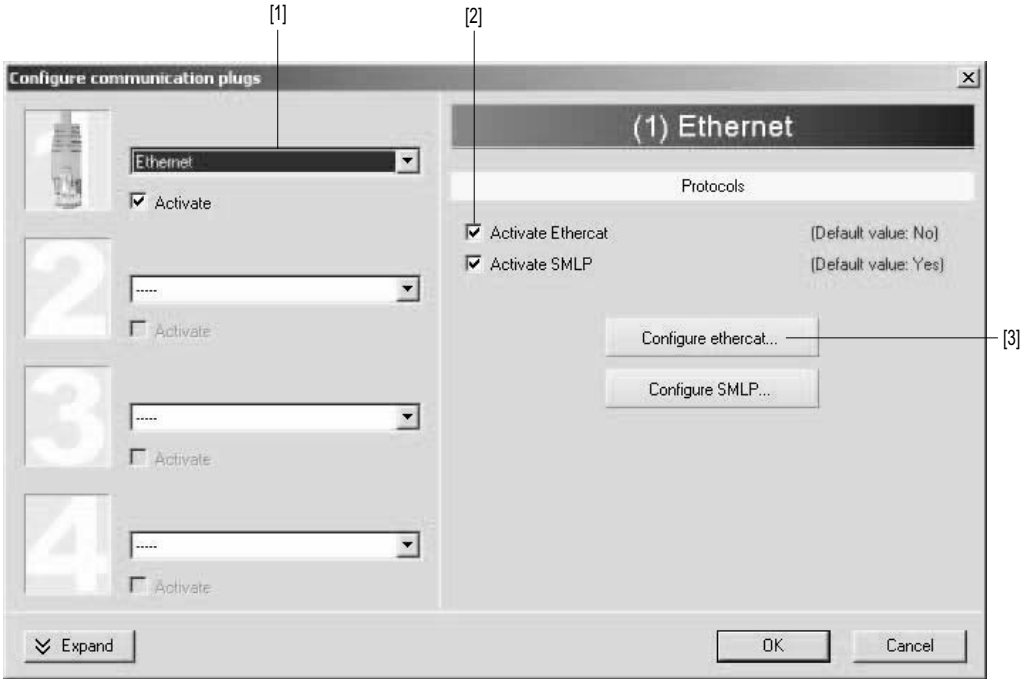
2. Configure an Ethernet interface. To do so, select the "Ethernet" option from the selection field [1]. Under "Protocols", tick the entry "Activate EtherCAT" [2]. Then click on the "Configure EtherCAT" button [3].



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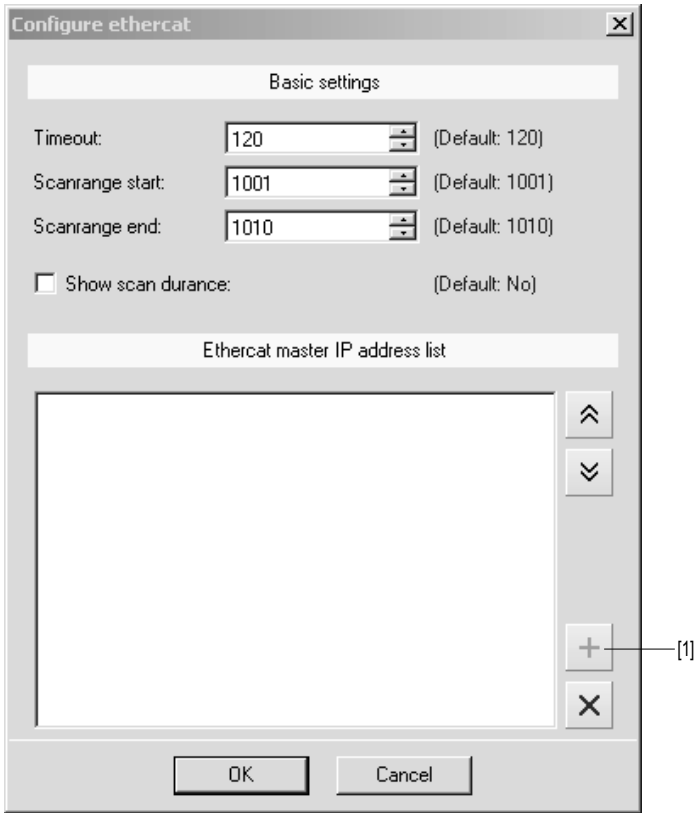
3. The "Configure EtherCAT" window opens. Click on the "+" button [1] to add the IP address of the mailbox gateway in the EtherCAT master.



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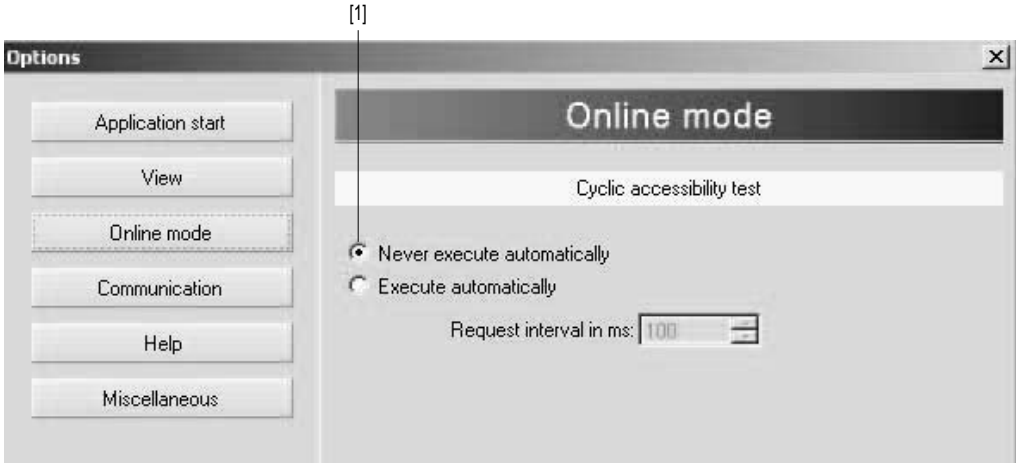
For the basic settings, observe the specified unit scan range ("Scan range start / end" fields). EtherCAT addresses 1001 to 1010 are scanned as standard. For large EtherCAT networks, you must adjust this unit scan range accordingly.

4. In the [Settings] / [Options] menu, call up the "Online mode" menu item. Ensure that the "Never execute automatically" [1] option is ticked in the "Cyclic accessibility" field.



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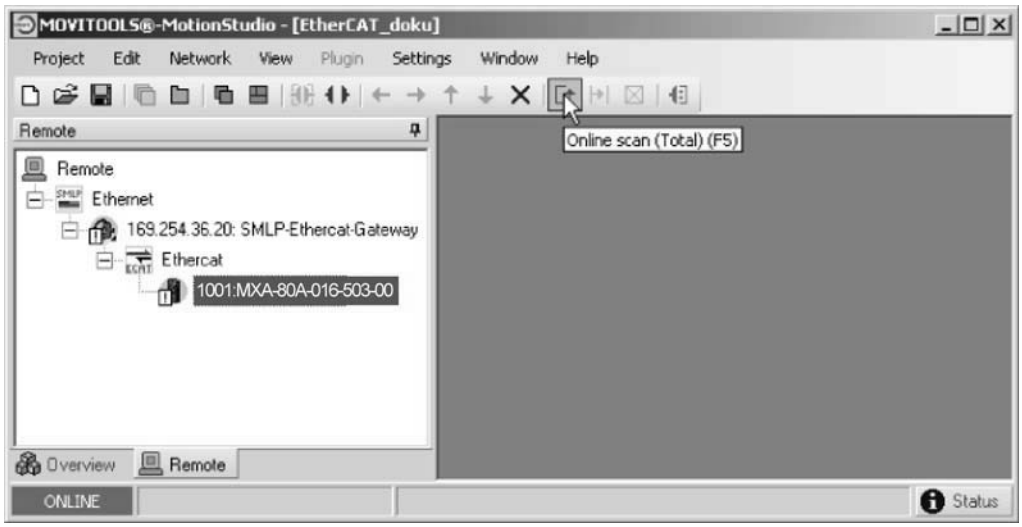
8.8 Automatic search for connected units (unit scan)

After pressing function key <F5> or the "Online scan" symbol , all configured communication channels are searched automatically and accessible units are displayed in the unit tree.



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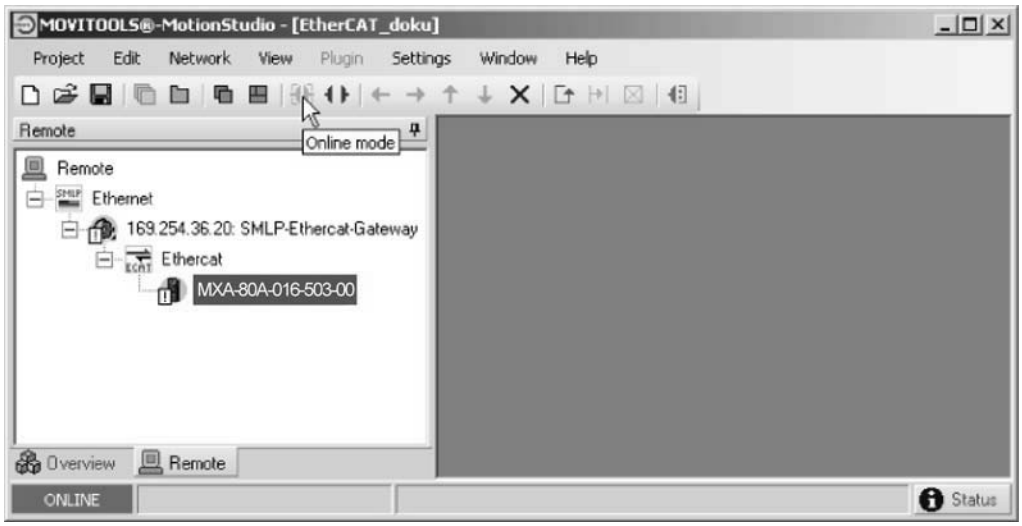
8.9 Activating online operation

- Perform the unit scan (see section 8.7).
- Use the mouse to mark the unit you want to operate. Switch MOVITOOLS® MotionStudio to online mode by clicking on the "Online mode" symbol (→ following figure).



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- Now highlight the unit you want to operate and activate the plug-in menu using the right mouse button.

8.10 Known problems when operating MOVITOOLS® MotionStudio

Check the following points if problems occur during configuration:

- Is the EtherCAT protocol activated in the communication settings of MOVITOOLS® MotionStudio?
- Is the correct IP address of the mailbox gateway set in the EtherCAT master?
- Is it possible to address the EtherCAT mailbox gateway via the "ping" command?
- Is the set unit scan range sufficient?
- Is the cyclical online accessibility test MOVITOOLS® MotionStudio deactivated?

9 Error Diagnostics

9.1 Diagnostic procedures

The diagnostic procedures described in the following section demonstrate the fault analysis methods for the following problems:

- Servo inverter does not work on EtherCAT.
- Servo inverter cannot be controlled using the EtherCAT master

For more specific information about configuration of the servo inverter for different fieldbus applications, refer to the "MOVIAXIS® Multi-Axis Servo Inverter" project planning manual.

Step 1: Checking for correct connection of the servo inverter to the EtherCAT

Is the bus connector connected to the master / servo inverter?	NO →	**[A]**
YES ↓		
How does the **Link / activity** LED on the XFE24A react?	OFF →	**[A]**
ON ↓		
Is the connection of the servo inverter to the EtherCAT physically correct? Check for correct EtherCAT connection at X30 IN (incoming EtherCAT connection) X31 OUT (outgoing EtherCAT connection).	NO →	**[A]**
YES ↓		
Continue with 2: Response of the RUN LED?		

[A]	Check the bus cabling.

Step 2: How does the RUN LED respond?

OFF	Has the master switched the slave into the INIT state?	YES → NO →	**[A]** **[B]**
Flashing orange	Bus has not been started up yet in the master.	→	**[C]**
Flashing green	Slave is in PRE-OPERATIONAL state.	→	**[C]**
Lights up once in green	Slave is in SAFE-OPERATIONAL state.	→	**[C]**
Lights up green	Slave is in OPERATIONAL state.	→	**[C]**

[A]	Startup the bus in the master.
[B]	XFE24A option is faulty.
[C]	Continue with 3: Response of the ERR LED?

Step 3: How does the ERR LED respond?

OFF	**Example 1:** RUN LED lights up green (slave is in OPERATIONAL state). ↓ The EtherCAT communication of the XFE24A option is in operating state. **Example 2:** • RUN LED flashes green (slave is in PRE-OPERATIONAL state). • RUN LED lights up green once (slave is in SAFE-OPERATIONAL state). ↓ Start the bus in the master and switch the slave to the OPERATIONAL state. ↓ Start process data communication.

Flickering	Prerequisite: • RUN LED flashes green (slave is in PRE-OPERATIONAL state). • RUN LED lights up green once (slave is in SAFE-OPERATIONAL state). ↓ A boot error was detected. Boot the XFE24A option. ↓ If the ERR LED continues to flicker, the XFE24A option is faulty.

Flashes red twice	**Example 1:** RUN LED lights up green (slave is in OPERATIONAL state). ↓ Fieldbus timeout, activate process output data. **Example 2:** • RUN LED flashes green (slave is in PRE-OPERATIONAL state). • RUN LED lights up green once (slave is in SAFE-OPERATIONAL state). ↓ Watchdog timeout → Start bus in the master and switch slave to OPERATIONAL state. ↓ Start process data communication.

Lights up red once	Prerequisite: • RUN LED flashes green (slave is in PRE-OPERATIONAL state). • RUN LED lights up green once (slave is in SAFE-OPERATIONAL state). ↓ An unprompted state change has occurred. Correct the configuration error and the start the bus in the master. ↓ Switch the slave to OPERATIONAL state. ↓ Start the process data communication.

Flashing	Prerequisite: • RUN LED flashes green (slave is in PRE-OPERATIONAL state). • RUN LED lights up green once (slave is in SAFE-OPERATIONAL state).
	↓
	An invalid configuration has occurred. Correct the configuration error and then start the bus in the master.
	↓
	Switch the slave to OPERATIONAL state.
	↓
	Start the process data communication.

9.2 List of errors

- For operating the XFE24A option in MOVIAXIS®, you will find the corresponding error codes in the MOVIAXIS® operating instructions.

10 Technical Data

10.1 XFE24A option for MOVIAXIS®

XFE24A option (MOVIAXIS®)	
Part number	1821 2492
Power consumption	P = 3 W
Standards	IEC 61158, IEC 61784-2
Baud rate	100 Mbaud full duplex
Connection technology	2 × RJ45 (8x8 modular jack)
Bus termination	Not integrated because bus termination is automatically activated.
OSI Layer	EtherNet II
Station address	Setting via EtherCAT master
Name of the XML file	SEW_XFE24A.XML
Vendor ID	0x59 (CANopenVendor ID)
EtherCAT services	• CoE (CANopen over EtherCAT) • VoE (Simple MOVILINK protocol over EtherCAT)
Firmware status MOVIAXIS®	Firmware status 23 or higher
Tools for startup	• PC program MOVITOOLS® MotionStudio from version 5.40

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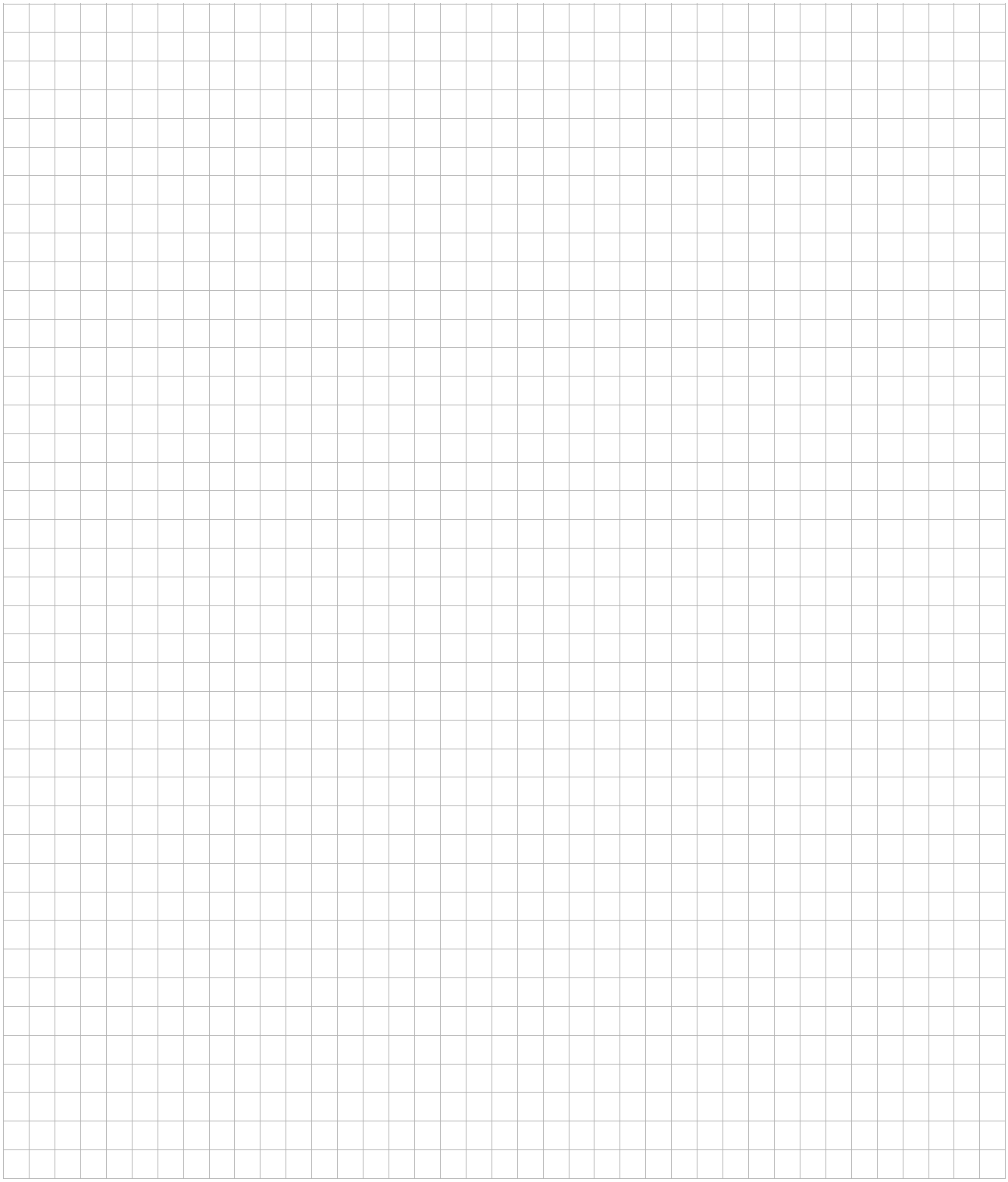


How we're driving the world

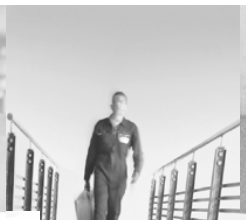
With people who think fast and develop the future with you.

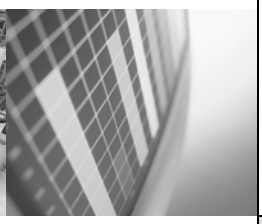
With a worldwide service network that is always close at hand.

With drives and controls that automatically improve your productivity.

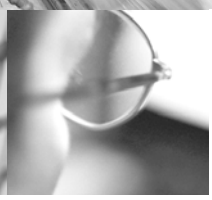
With comprehensive knowledge in virtually every branch of industry today.

With uncompromising quality that reduces the cost and complexity of daily operations.





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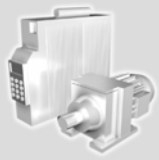
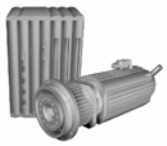
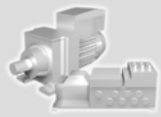
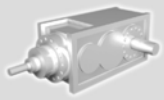

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